

**Coso Monitoring Program**  
**October 1995 Through September 1996**

by  
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**JANUARY 1997**

**NAVAL AIR WEAPONS STATION**  
**CHINA LAKE, CA 93555-6100**



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# Naval Air Weapons Station

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## FOREWORD

This report presents the status of the Coso Monitoring Program conducted for the period October 1995 through September 1996 by the Naval Air Weapons Station (NAWS), China Lake, Calif. The investigation, funded under the NAWS Coso Geothermal Development Program, is being conducted to provide baseline information on hydrology and surface geothermal activity in the Coso Hot Springs area.

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## INTRODUCTION

The Coso Monitoring Program was initiated in 1978 to gather baseline data on the surface and near-surface geothermal activity at Devils Kitchen and Coso Hot Springs located inside the boundaries of the Naval Air Weapons Station (NAWS), China Lake, Calif., the main thermal sites within the Coso Known Geothermal Resource Area (Coso KGRA). This report represents the nineteenth year of continuous data collection.

The format of the report for the current reporting period hasn't been changed from last year's report. A substantial body of reports has been established on this project (15 technical publications) and the project is essentially the same year to year, therefore much of the text of each report reiterates previously published information. This year's report concentrates on data presentation and interpretation and the reader is referred to the 1993/1994 summary report (Reference 1) for detailed descriptions of the overall project and the individual sites monitored.

Seasonal and diurnal variations of the thermal activity in these hot spring areas continue to be evident. Overall, the level of activity has been very stable during this reporting period.

Monitoring sites of the Coso Hot Springs area and type of data collected at each site are presented in Table 1. The location of each site is shown in Figure 1.

TABLE 1. Monitoring Functions and Locations.

Monitored sites	Continuous steam flow	Wellhead pressure	Periodic water level	Periodic water temperature	Water level photography	Water chemistry	Ambient temperature	Barometric pressure	Relative humidity	Wind speed and direction
Schober's Resort (Wells 4A-2, 3)	X									
Well 4A-4			X <sup>a</sup>	X						
Well 4H-4	X									
Well 4P-1			X <sup>b</sup>	X		X				
Well 4H-8 (Coso No. 1)		X <sup>c</sup>		X		X				
Devils Kitchen	X					X				
Observation Well No. 1			X <sup>b</sup>	X		X				
Observation Well No. 2			X <sup>b</sup>							
South Pool			X <sup>b</sup>	X	X	X				
Weather Station							X	X	X	X

<sup>a</sup>Less than weekly monitoring.<sup>b</sup>Weekly monitoring.<sup>c</sup>Weekly shut-in wellhead pressures.



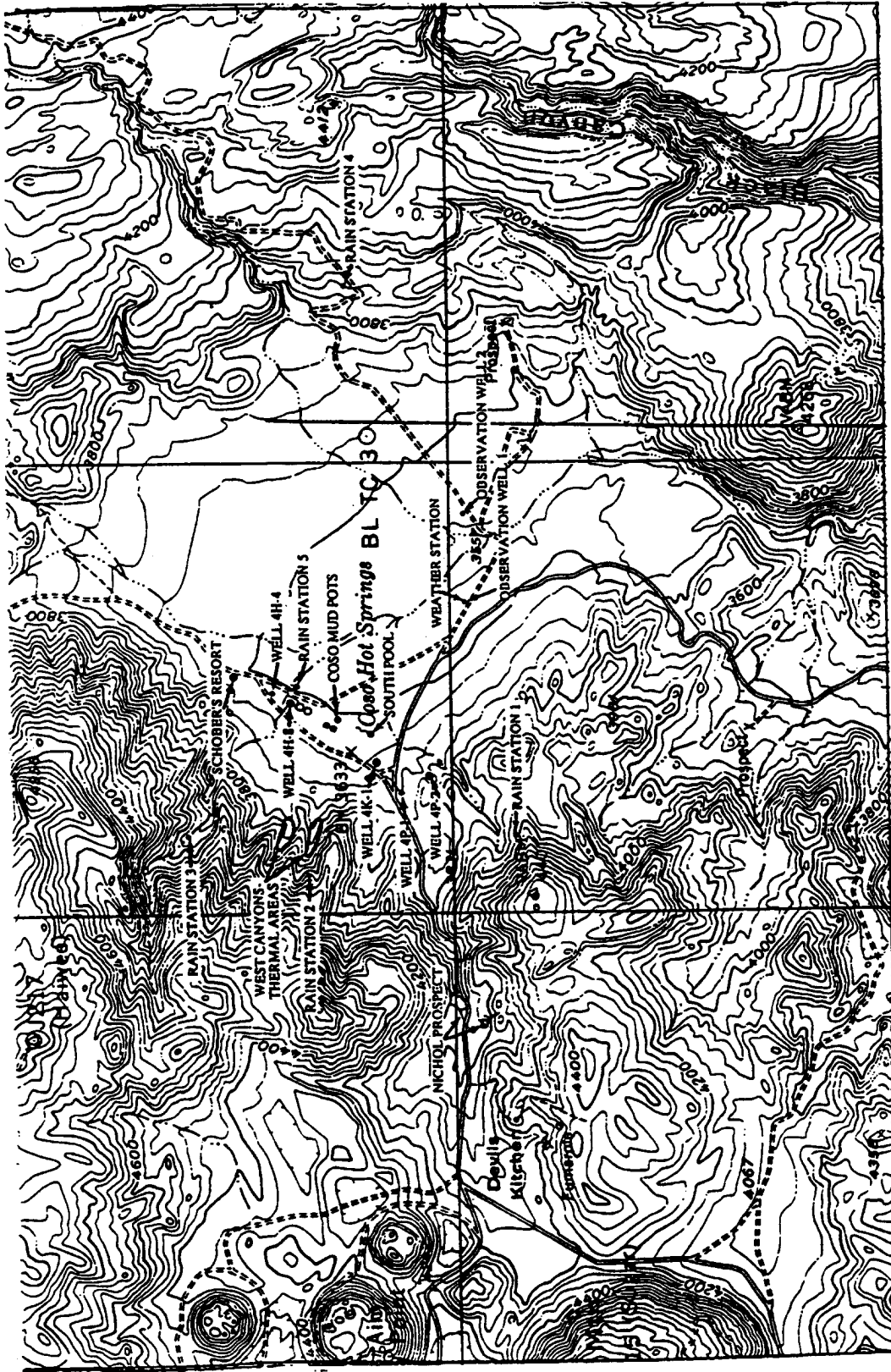


FIGURE 1. Coso Known Geothermal Resource Area Monitoring Sites.

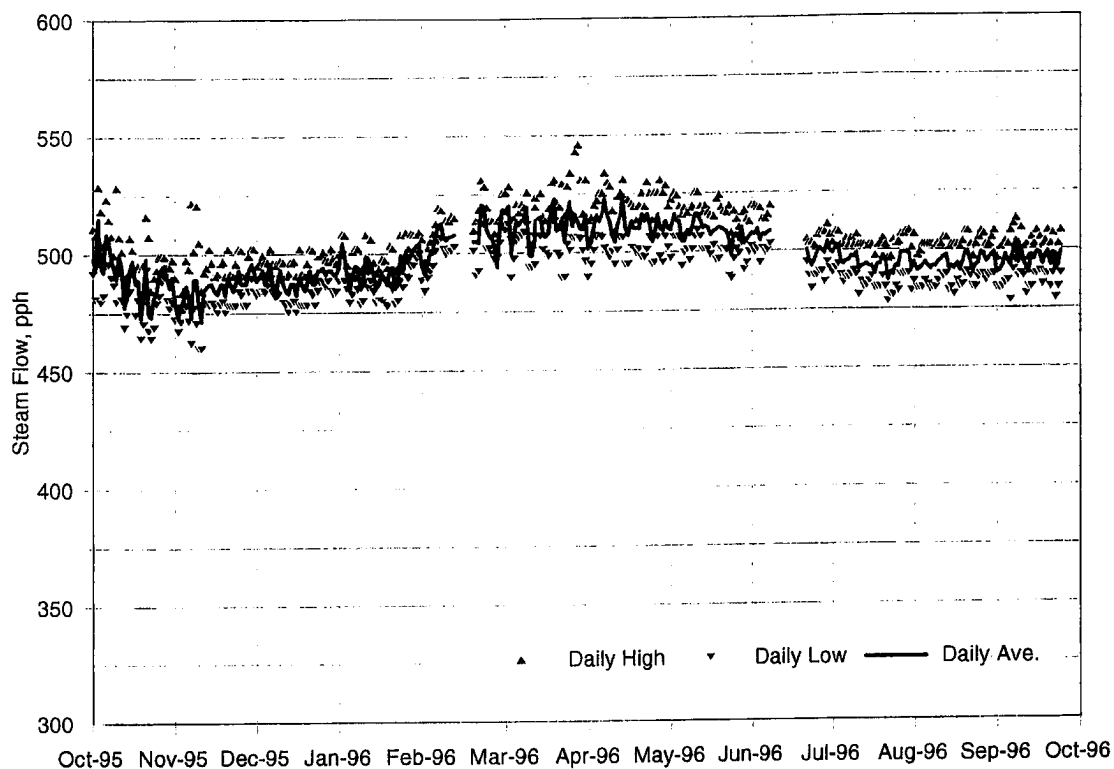


FIGURE 2. Devils Kitchen Steam Flow, October 1995 Through September 1996.

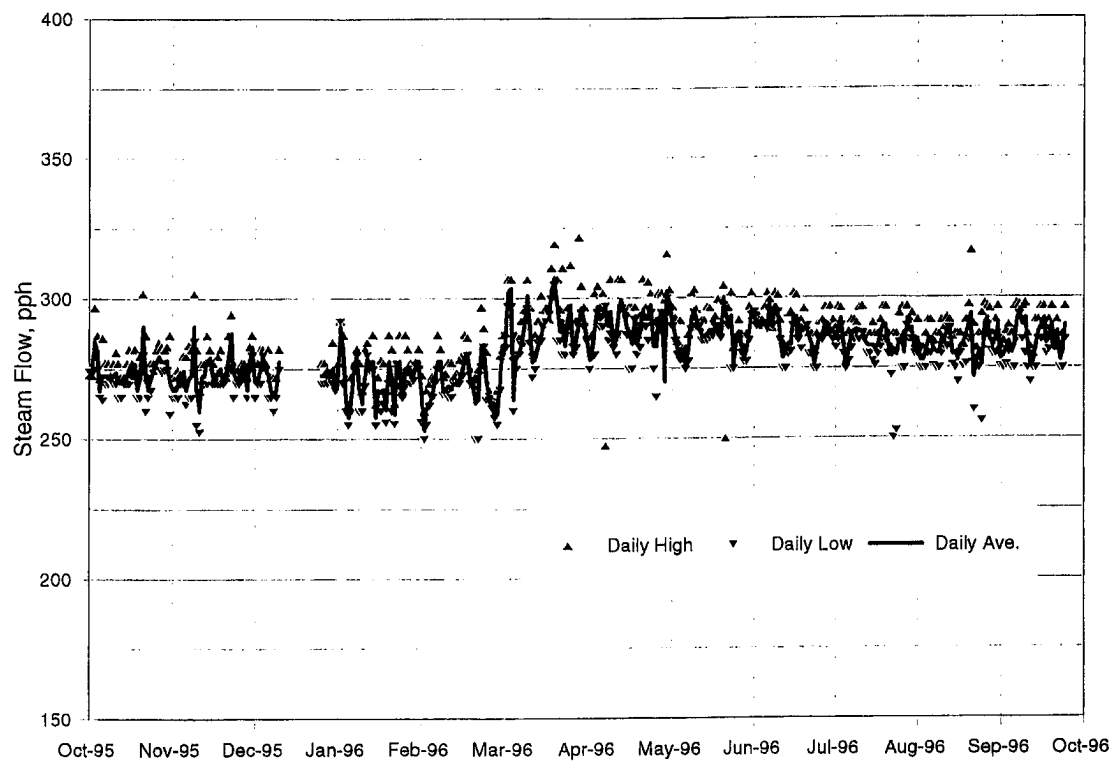


FIGURE 3. Well 4H-4 Steam Flow, October 1995 Through September 1996.

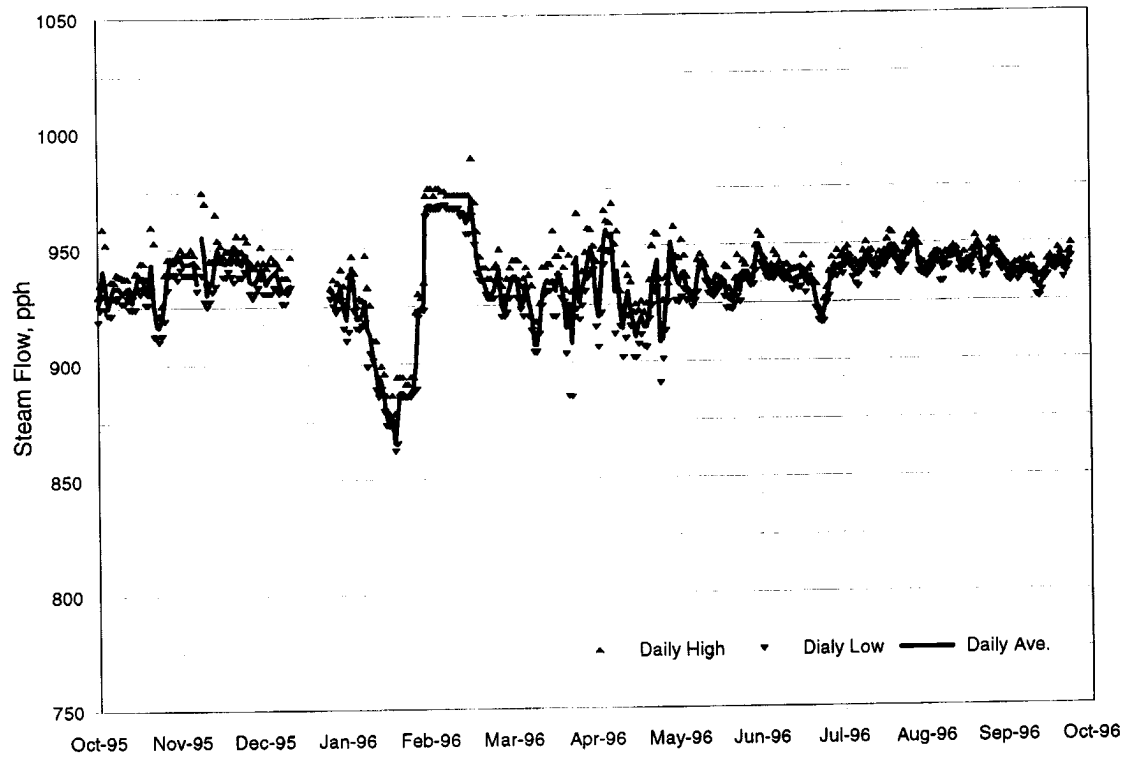


FIGURE 4. Wells 4A-2 and 4A-3 Steam Flow, October 1995 Through September 1996.

## **COSO HOT SPRINGS MUDFIELD PHOTOGRAPHIC RECORD**

A weekly photographic record was initiated in January 1978 to document the fluctuation in fluid levels in several of the more prominent mud pots in the Coso KGRA. Over the years the photo record has provided a clear picture of this hot springs thermal activity. It has demonstrated the sensitivity of the hot springs to both seasonal weather changes and individual weather events, such as summer thunderstorms. It has also chronicled the changes in thermal activity that occurred throughout the Coso Hot Springs area in the late 1980s. This weekly photo record was continued through this reporting period and is catalogued and stored at the Geothermal Program Office.

Selected photographs, Figures 5 through 13, show the typical level of thermal activity in the hot springs area throughout the past year.



FIGURE 5. Resort Mud Pot Area, August 1996.

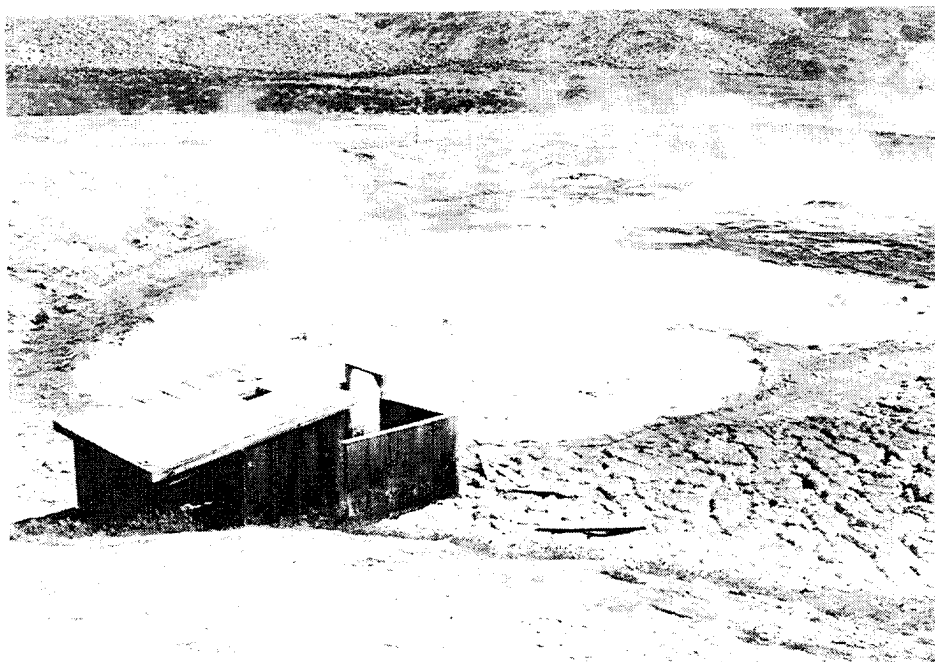


FIGURE 6. South Pool, High Water Level, May 1996.

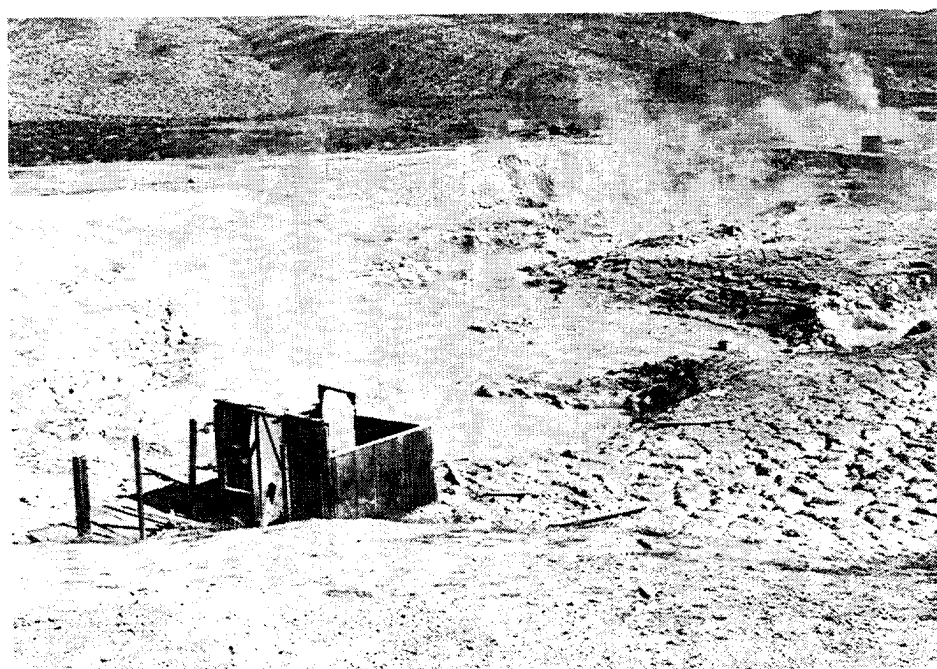


FIGURE 7. South Pool, Low Water Level, September 1996.

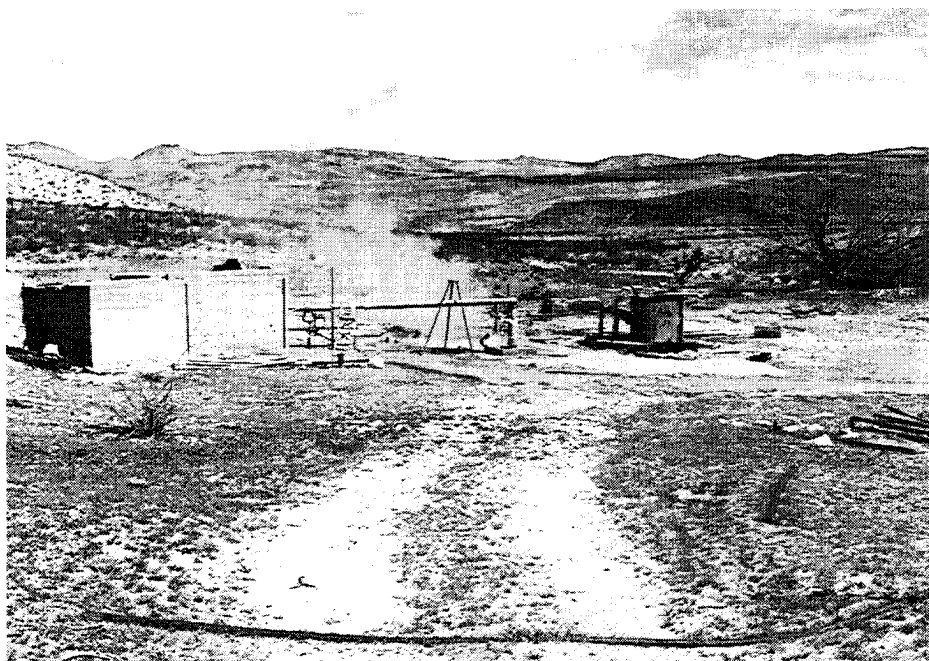


FIGURE 8. Schober's Resort Area, March 1996.



FIGURE 9. West Canyon, Looking West Up Canyon, March 1996.

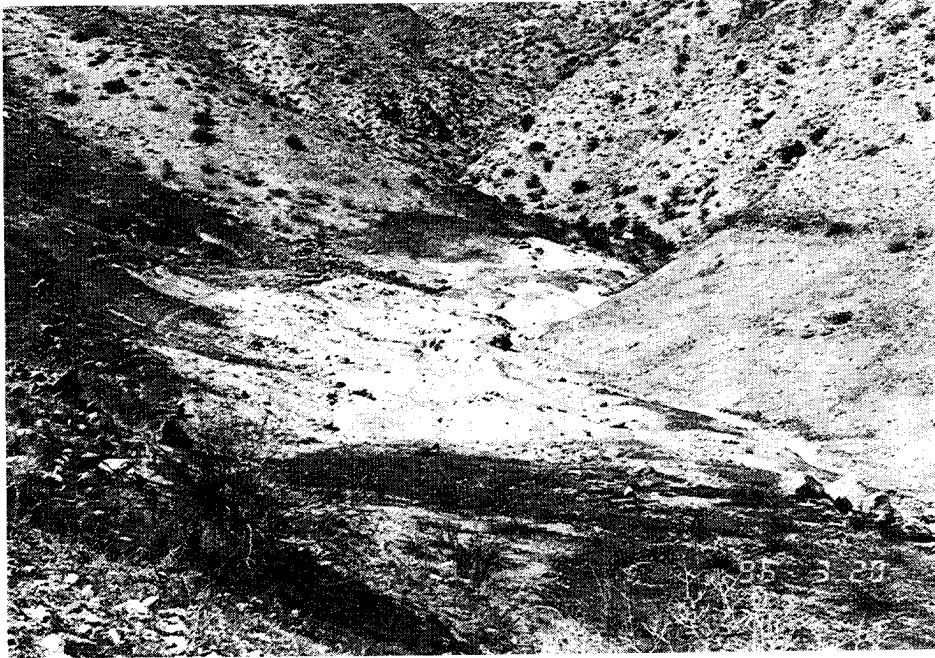


FIGURE 10. Northern West Canyon Land Slump, March 1996.

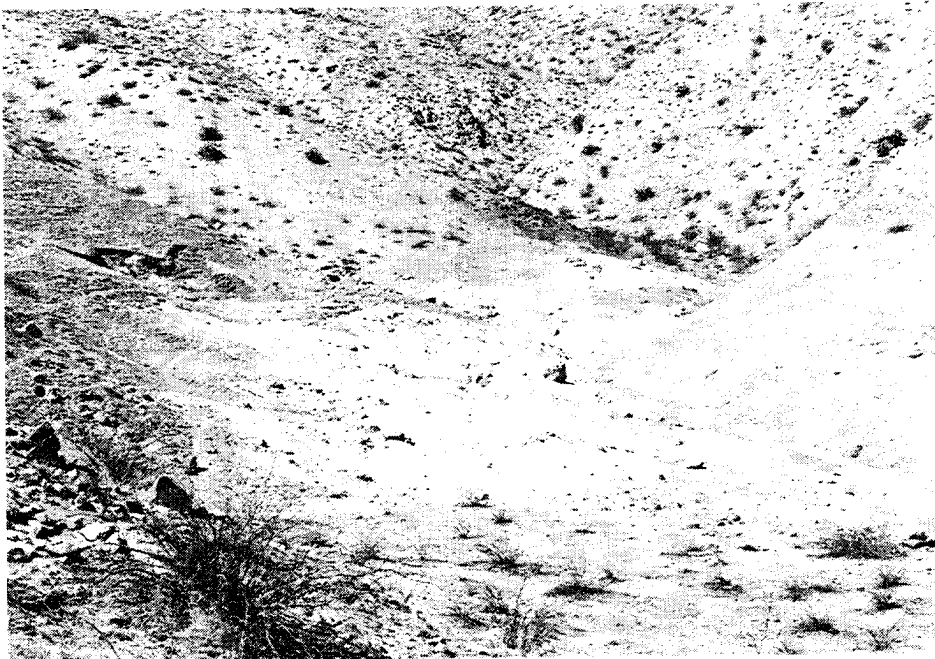


FIGURE 11. Northern West Canyon Land Slump, October 1996.





FIGURE 12. Nichol Prospect Warm Pool, March 1996.

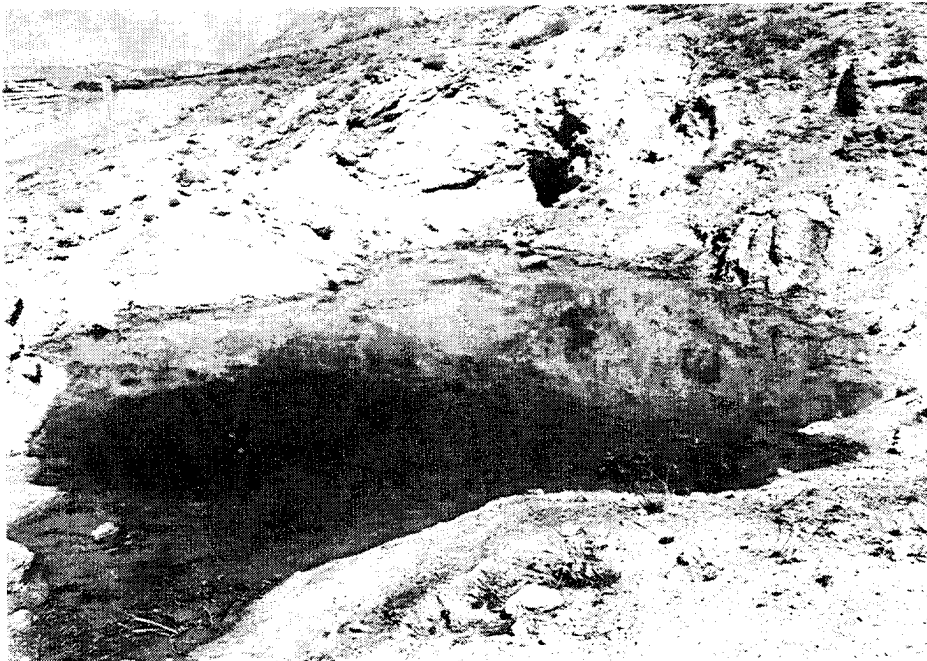


FIGURE 13. Nichol Prospect Warm Pool, August 1996.



## WATER LEVEL MONITORING

### OBSERVATION WELLS

Groundwater levels are monitored in four wells. Weekly measurements are taken at wells 4P-1, OB-1 and OB-2, while the water level of another well, Coso No. 1 (4H-8), is determined indirectly from temperature logs and weekly wellhead pressure readings. These level data are listed in Table 2. Figure 14 shows a summary graph of Coso observation well water levels from 1980 to the present. Depth to water data have been translated to true elevation.

The fluid level elevation in well 4P-1 continues to gradually rise, from 3590.5 feet above sea level (ASL) at the beginning of the monitoring program in 1978 to 3613.3 feet ASL at the end of September 1996. Well 4P-1 is a hot, steam condensate well and is located on the upthrown side of the Coso Hot Springs fault, about 150 feet from the fault line, toward the south end of the hot springs area. It is completed in alluvial fill material. As discussed in Reference 2, this well appears to tap a small perched aquifer that is not directly connected to the regional aquifer.

Observations wells OB-1 and OB-2 are water wells located in the Upper Coso Basin, about three-quarters of a mile east of the fault line. Both of these wells are completed in sedimentary, valley fill material. The water level elevation in OB-1 continues the decline described in previous reports, dropping from about 3432 feet ASL in 1988 to about 3386.8 feet ASL by September 1996. The water level in OB-2, however, rose about 10 feet during 1989 and 1990. This level appears to have stabilized at about 3365 feet ASL.

Coso No. 1 is located toward the north end of the Coso Hot Springs fault and is completed in bedrock. The fluid level in Coso No. 1 declined slightly from 3473 to about 3465 feet ASL between 1978 and October 1987. At that lowered fluid level, the well began to boil. The fluid level dropped rapidly to about 3410 feet ASL by September 1988, and the wellbore became plugged with salt and scale. Coso No. 1 was rehabilitated in 1993 and shut-in to reduce boiling and scaling. The current fluid level (determined from the temperature gradient log) is at about 3300 feet ASL.

Shut-in wellhead pressures for Coso No. 1 are recorded weekly from both the 4-inch wellbore and the 7-inch intermediate casing around the wellbore. The wellbore is completed to 370 feet in bedrock, while the intermediate casing is set to 194 feet at the alluvium/bedrock interface. Table 3 is a listing of the current year's recorded pressures. Figure 15 is a summary graph of these pressures from November 1993 to the present.

TABLE 2. Observation Well Water Level Data.

Date	Water level elevations, ft, AMSL			
	Ground level at well location, ft, AMSL			Ground level, ft, AMSL
	4P-1	OB-1	OB-2	Coso 1
	3662.0	3570.0	3560.0	3615.0
	Water level measurements			Water level <sup>a</sup>
	4P-1	OB-1	OB-2	Coso 1
10 Oct 95	3612.1	3387.9	3366.6	3300.0
17 Oct 95	3612.1	3386.8	3366.6	
24 Oct 95	3612.1	3386.8	3365.5	
31 Oct 95	3612.1	3386.8	3365.5	
7 Nov 95	3610.9	3386.8	3365.5	
14 Nov 95	3610.9	3386.8	3365.5	
24 Nov 95	3610.9	3386.8	3365.5	
28 Nov 95	3612.1	3386.8	3364.3	
5 Dec 95	3612.1	3386.8	3365.5	
12 Dec 95	3612.1	3386.8	3365.5	
3 Jan 96	3612.1	3386.8	3365.5	
9 Jan 96	3612.1	3385.6	3365.5	
16 Jan 96	3612.1	3385.6	3365.5	
24 Jan 96	3612.1	3386.8	3365.5	
31 Jan 96	3612.1	3386.8	3365.3	
7 Feb 96	3612.1	3386.8	3365.5	
14 Feb 96	3612.1	3386.8	3365.5	
21 Feb 96	3612.1	3386.8	3364.3	
28 Feb 96	3612.1	3386.8	3365.5	
6 Mar 96	3612.1	3386.8	3365.5	
13 Mar 96	3612.1	3386.8	3365.5	
20 Mar 96	3612.1	3386.8	3365.5	
27 Mar 96	3613.3	3386.8	3365.5	
3 Apr 96	3613.3	3386.8	3365.5	
10 Apr 96	3613.3	3386.8	3365.5	
18 Apr 96	3612.1	3386.8	3365.5	
25 Apr 96	3612.1	3386.8	3365.5	
2 May 96	3612.1	3386.8	3365.5	
9 May 96	3613.3	3386.8	3365.5	
15 May 96	3612.1	3386.8	3365.5	
23 May 96	3612.1	3386.8	3364.3	
29 May 96	3612.1	3386.8	3365.5	
5 Jun 96	3612.1	3386.8	3365.5	
12 Jun 96	3612.1	3386.8	3364.3	
20 Jun 96	3612.1	3386.8	3365.5	
26 Jun 96	3612.1	3386.8	3365.5	
3 Jul 96	3612.1	3386.8	3365.5	
10 Jul 96	3612.1	3385.6	3365.5	
17 Jul 96	3610.9	3385.6	3365.5	
24 Jul 96	3610.9	3385.6	3365.5	
1 Aug 96	3610.9	3385.6	3365.5	
7 Aug 96	3613.3	3385.6	3365.5	
14 Aug 96	3613.3	3386.6	3365.5	
21 Aug 96	3613.3	3386.8	3365.5	
28 Aug 96	3613.3	3386.8	3365.5	
4 Sep 96	3613.3	3386.8	3365.5	
11 Sep 96	3613.3	3386.8	3365.5	
18 Sep 96	3613.3	3386.8	3365.5	
26 Sep 96	3613.3	3386.8	3365.5	

<sup>a</sup> Coso 1 water level is determined indirectly from temperature logs and weekly wellhead pressure readings.

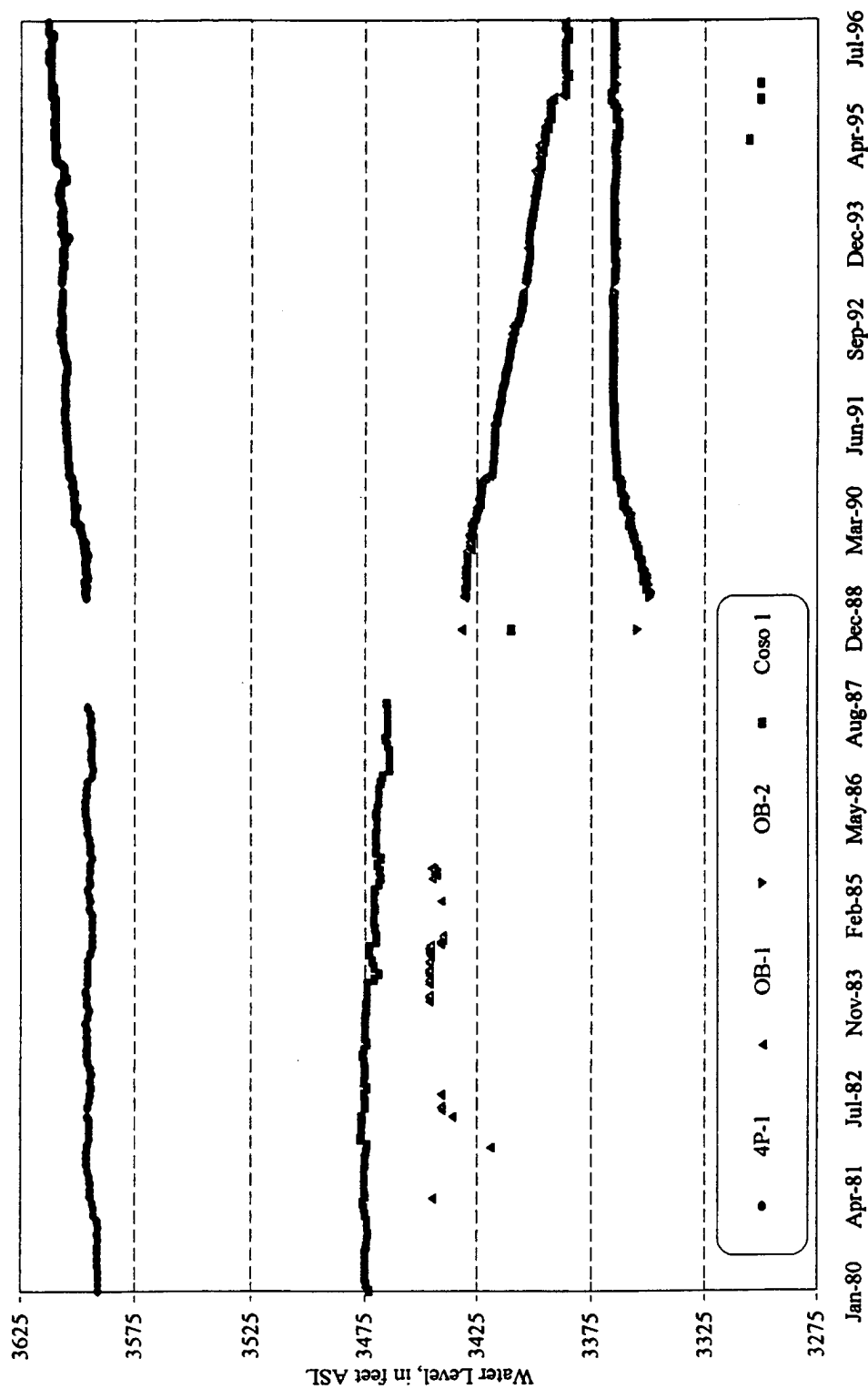


FIGURE 14. Water Levels in Coso Observation Wells, January 1980 Through September 1996.

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TABLE 3. Shut-in Wellhead Pressure, Coso No. 1.

Date	7-inch casing, psig	4-inch casing, psig
10 Oct 95	21.5	20.0
17 Oct 95	22.0	20.0
24 Oct 95	22.0	20.0
31 Oct 95	22.0	20.0
7 Nov 95	22.0	20.0
14 Nov 95	22.0	20.0
24 Nov 95	22.0	20.0
28 Nov 95	22.0	20.0
5 Dec 95	22.0	20.0
12 Dec 95	24.0	20.0
3 Jan 96	24.0	20.0
9 Jan 96	24.0	20.0
16 Jan 96	24.0	20.0
24 Jan 96	24.0	20.0
31 Jan 96	24.5	20.0
7 Feb 96	24.5	20.0
14 Feb 96	24.5	20.0
21 Feb 96	24.5	20.0
28 Feb 96	24.0	19.6
6 Mar 96	24.0	20.0
13 Mar 96	24.5	20.0
20 Mar 96	24.5	20.0
27 Mar 96	24.5	20.5
3 Apr 96	24.5	20.5
10 Apr 96	24.5	20.5
18 Apr 96	24.5	20.5
25 Apr 96	24.5	20.5
2 May 96	25.0	20.0
9 May 96	24.5	20.5
15 May 96	24.5	20.5
23 May 96	24.5	20.0
29 May 96	24.5	20.5
5 Jun 96	24.5	20.5
12 Jun 96	25.0	20.0
20 Jun 96	24.5	20.5
26 Jun 96	24.5	20.5
3 Jul 96	24.5	20.5
10 Jul 96	24.5	20.5
17 Jul 96	24.5	20.5
24 Jul 96	24.5	20.5
1 Aug 96	24.5	20.5
7 Aug 96	24.5	20.5
14 Aug 96	24.5	20.5
21 Aug 96	24.5	20.5
28 Aug 96	25.0	20.5
4 Sep 96	24.5	20.5
11 Sep 96	24.5	20.5
18 Sep 96	24.5	20.0
26 Sep 96	24.5	20.5

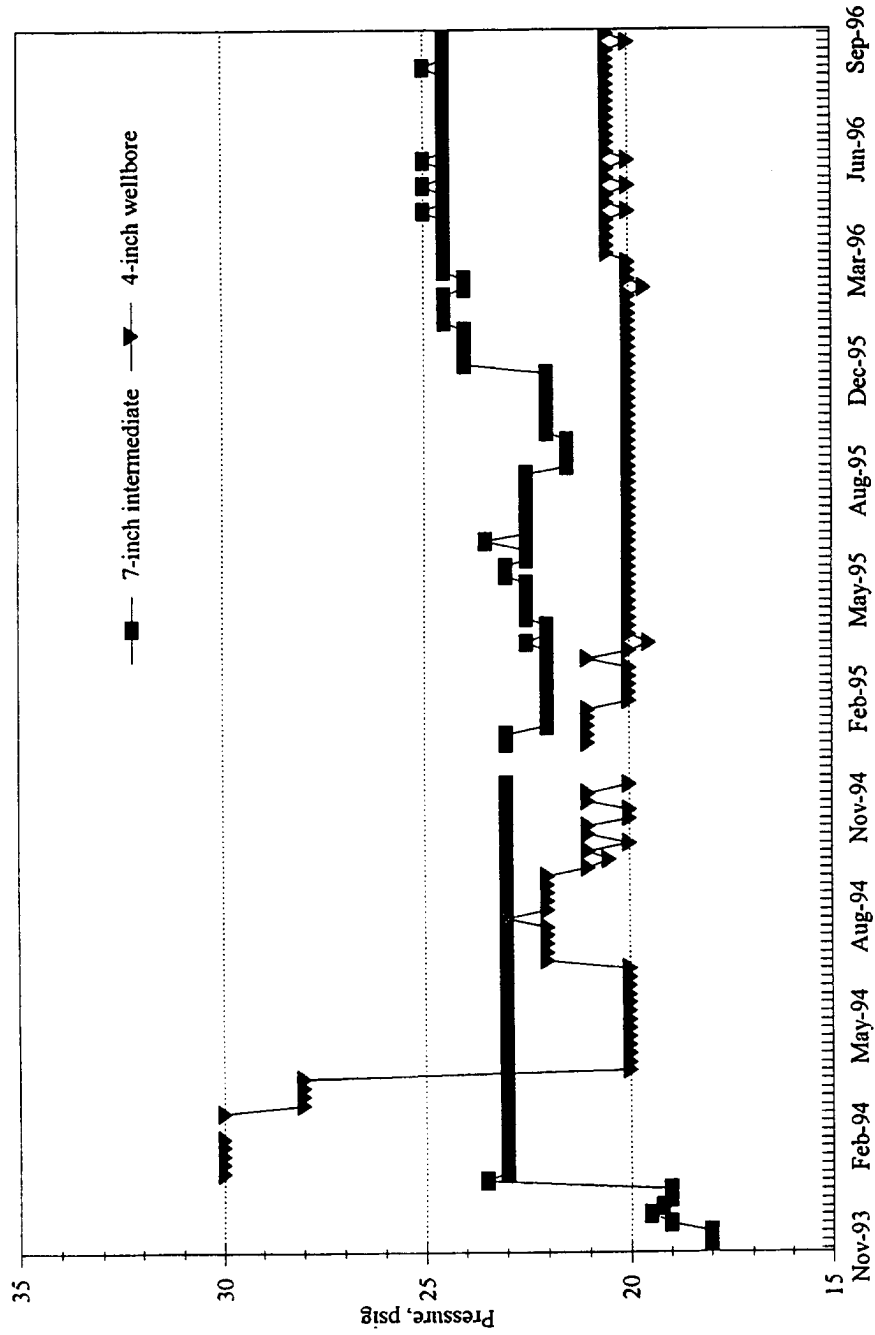


FIGURE 15. Shut-in Wellhead Pressure, Coso No. 1, November 1993 Through September 1996.

**SOUTH POOL**

The South Pool water level has continued the pattern of seasonal fluctuations throughout this reporting period, ranging from a low of 3612.2 feet in October 1995 to a high of 3620.4 feet in March of 1996 (Table 4). The pool's temperature is periodically measured, as conditions permit. Water temperatures for this period continued to average above 200 degrees Fahrenheit. The temperature and water elevations of the pool for January 1988 through September 1996, the period of increased activity, are shown graphically in Figure 16, while the pool elevation recorded for the entire monitoring program period is shown in Figure 17.

TABLE 4. South Pool Elevation and Temperature Changes.

Date	Elevation, ft	Temperature, °F	Date	Elevation, ft	Temperature, °F
10 Oct 95	3616.4	200	18 Apr 96	3620.0	211
17 Oct 95	3616.3	198	25 Apr 96	3620.1	209
24 Oct 95	3616.2	199	2 May 96	3620.4	208
31 Oct 95	3616.5	187	9 May 96	3619.6	208
7 Nov 95	3616.9	190	15 May 96	3619.5	207
14 Nov 95	3616.9	190	23 May 96	3619.0	206
21 Nov 95	3617.2	189	29 May 96	3619.4	205
28 Nov 95	3617.2	182	5 Jun 96	3619.1	204
5 Dec 95	2617.2	183	12 Jun 96	3619.4	204
12 Dec 95	3617.2	182	20 Jun 96	3618.5	210
3 Jan 96	3618.1	190	26 Jun 96	3618.3	no data
9 Jan 96	3618.4	no data	3 Jul 96	3618.1	204
16 Jan 96	3618.6	195	10 Jul 96	3617.9	205
24 Jan 96	3618.8	212	17 Jul 96	3617.6	207
31 Jan 96	3619.0	no data	24 Jul 96	3617.3	206
7 Feb 96	3619.0	205	1 Aug 96	3617.0	203
14 Feb 96	3619.1	202	7 Aug 96	3617.1	201
21 Feb 96	3619.3	205	14 Aug 96	3616.7	203
28 Feb 96	3619.7	205	21 Aug 96	3616.6	201
6 Mar 96	3619.7	206	28 Aug 96	3616.4	207
13 Mar 96	3619.4	204	4 Sep 96	3616.2	no data
20 Mar 96	3620.0	205	11 Sep 96	3616.3	211
27 Mar 96	3620.4	207	18 Sep 96	3616.3	211
3 Apr 96	3620.0	210	26 Sep 96	3616.3	211
10 Apr 96	3619.6	209			

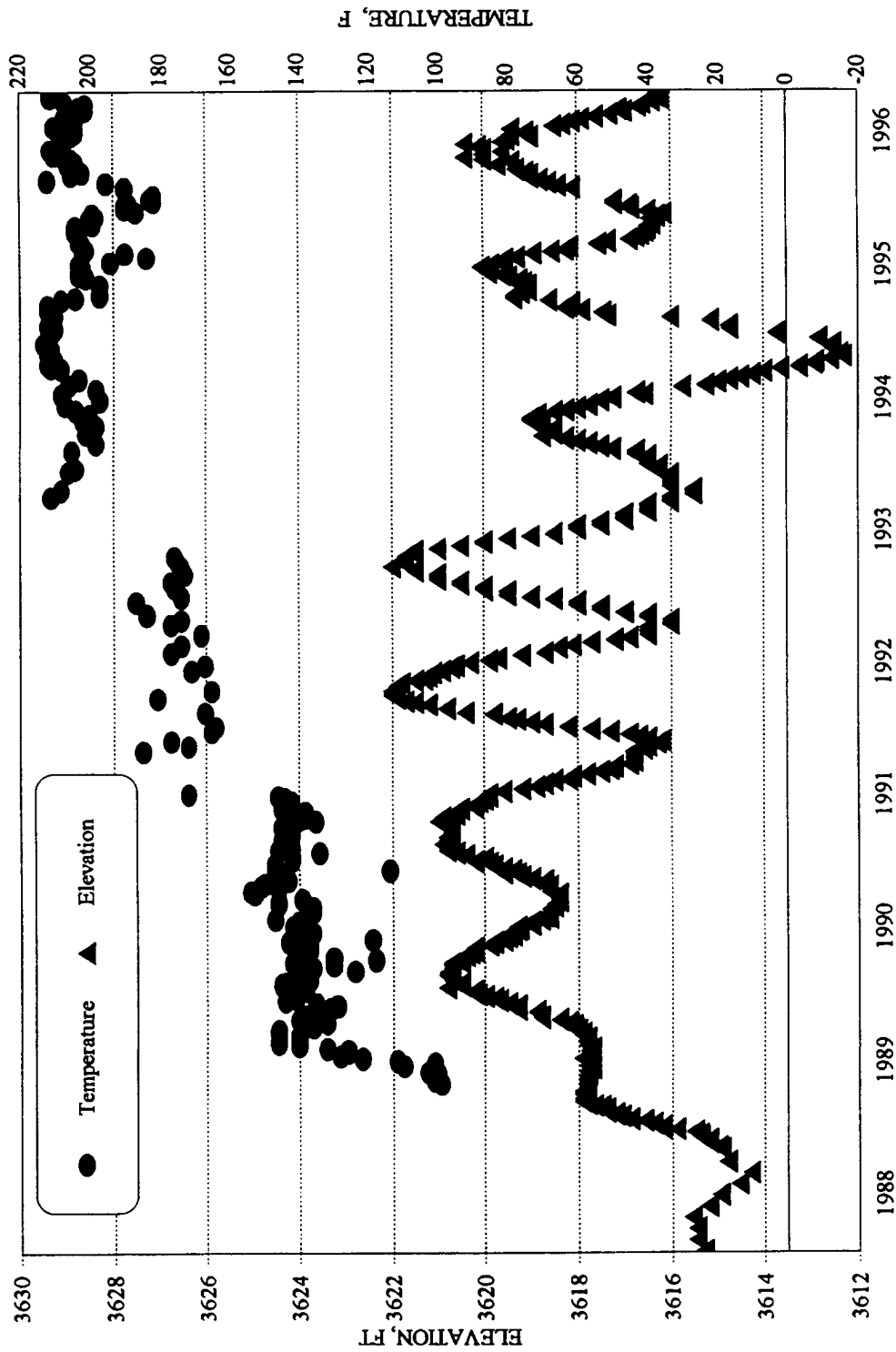


FIGURE 16. South Pool Elevation and Temperature, January 1988 Through September 1996.

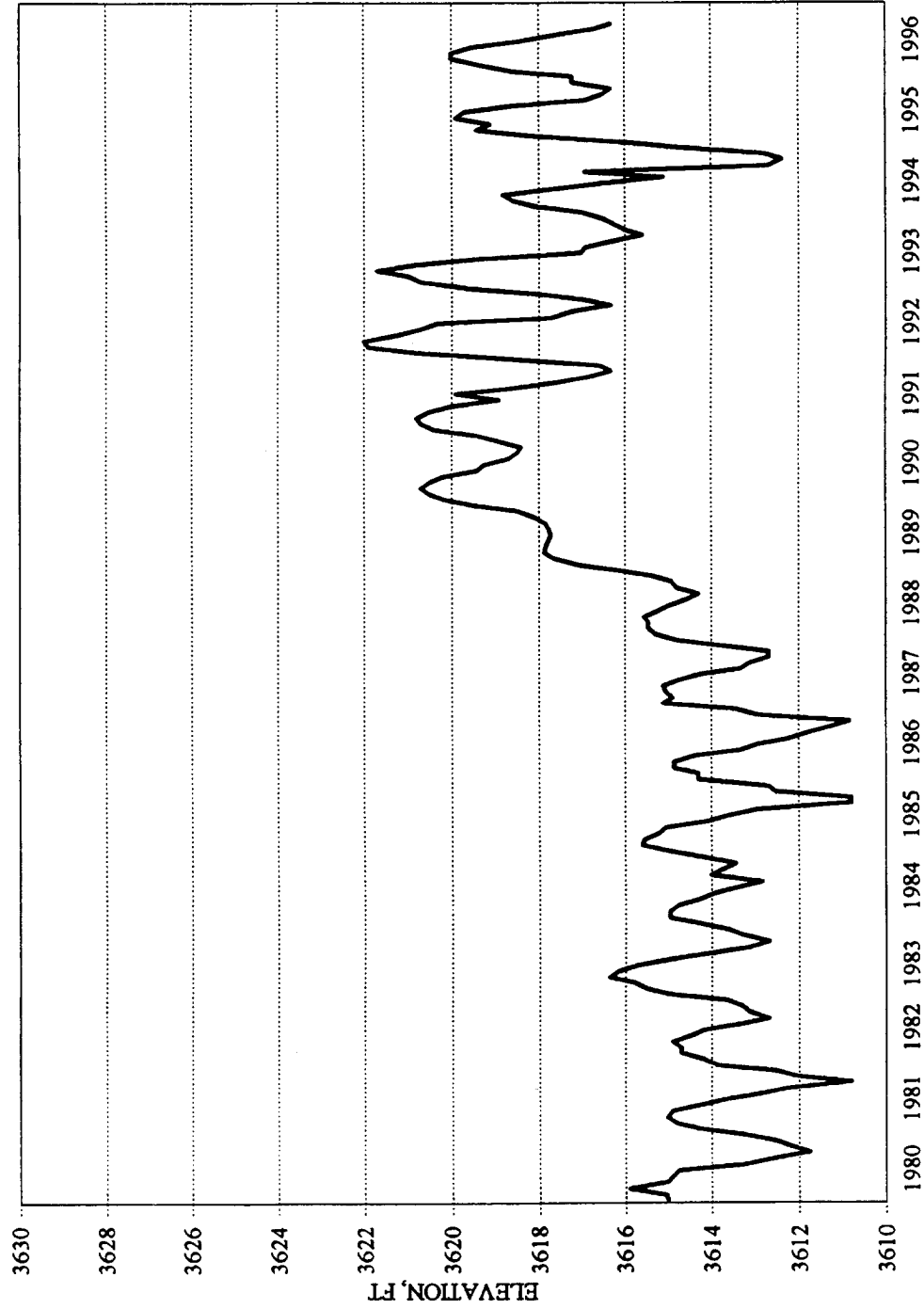


FIGURE 17. South Pool Elevations, January 1980 Through September 1996.



### RAINFALL AT COSO RESORT AREA AND ROSE VALLEY

Rainfall in the Coso Hot Springs basin is monitored at five rain station sites, as mapped in Figure 1. Instrumentation at each site consists of a battery-operated long-term strip recorder that is triggered by a tipping bucket. The Rose Valley data are collected at the Los Angeles Department of Water and Power Haiwee Reservoir Plant. This year there were no interruptions in rainfall data collection.

Data from the Coso rain stations and the Rose Valley data from the Haiwee power plant are presented in Table 5 and Figure 18. Comparative rainfall data for the Indian Wells Valley (IWV), Rose Valley, and Coso Basin for the period 1967 through 1995 are shown in Table 6 and Figure 19. IWV data were gathered at Armitage Field, Naval Air Warfare Center Weapons Division (NAWCWPNS), and provided by a NAWCWPNS meteorologist.

TABLE 5. Rainfall Recorded at the Coso Rain Stations and Rose Valley.

Coso Hot Springs area						Rose Valley	
Date	Tipping bucket stations (rainfall, in.)					Date	Rainfall, in.
	1	2	3	4	5		
03 Oct 95		0.02					
26 Nov 95	0.01						
12 Dec 95	0.07					12 Dec 95	0.05
17 Dec 95			0.01			13 Dec 95	0.40
18 Dec 95			0.09			14 Dec 95	0.08
23 Dec 95	0.03					23 Dec 95	0.34
24 Dec 95	0.10						
30 Dec 95			0.15				
31 Dec 96			0.03				
21 Jan 96			0.04			19 Jan 96	0.82
16 Jan 96	0.01					25 Jan 96	0.03
30 Jan 96		0.02				28 Jan 96	0.12
31 Jan 96		0.18	0.38				
01 Feb 96			0.04		0.02	31 Jan 96	0.01
17 Feb 96				0.01		01 Feb 96	0.20
19 Feb 96	0.02	0.03	0.01			02 Feb 96	0.01
20 Feb 96	0.04	0.14	0.20			20 Feb 96	0.48
23 Feb 96					0.02	21 Feb 96	0.20
26 Feb 96	0.05						
28 Feb 96		0.04	0.02				
01 Mar 96	0.01						
02 Mar 96					0.03		
07 Mar 96				0.08		05 Mar 96	0.06

TABLE 5. (Contd.)

Coso Hot Springs area						Rose Valley	
Date	Tipping bucket stations (rainfall, in.)					Date	Rainfall, in.
	1	2	3	4	5		
09 Mar 96	0.06						
10 Mar 96	0.07						
12 Mar 96		0.08	0.04				
13 Mar 96		0.11	0.21	0.07		13 Mar 96	0.06
17 Mar 96					0.02	14 Mar 96	0.13
18 Mar 96					0.09	15 Mar 96	0.05
19 Mar 96	0.04						
29 Mar 96	0.06						
02 Apr 96			0.02				
07 Apr 96					0.04		
14 Apr 96	0.02					01 Apr 96	0.01
17 Apr 96			0.01			17 Apr 96	0.02
21 Apr 96					0.02	18 Apr 96	0.11
25 May 96			0.06			25 May 96	0.12
29 May 96					0.01	26 May 96	0.13
26 Jun 96	0.02	0.03			0.03	27 Jun 96	0.01
12 Jul 96		0.03				13 Jul 96	0.26
30 Jul 96					0.01	28 Jul 96	0.10
14 Aug 96	0.01				0.01		
14 Sep 96	0.01						
19 Sep 96	0.01		1.31				
TOTAL	0.64	0.68	1.13	0.16	0.30	TOTAL	3.8

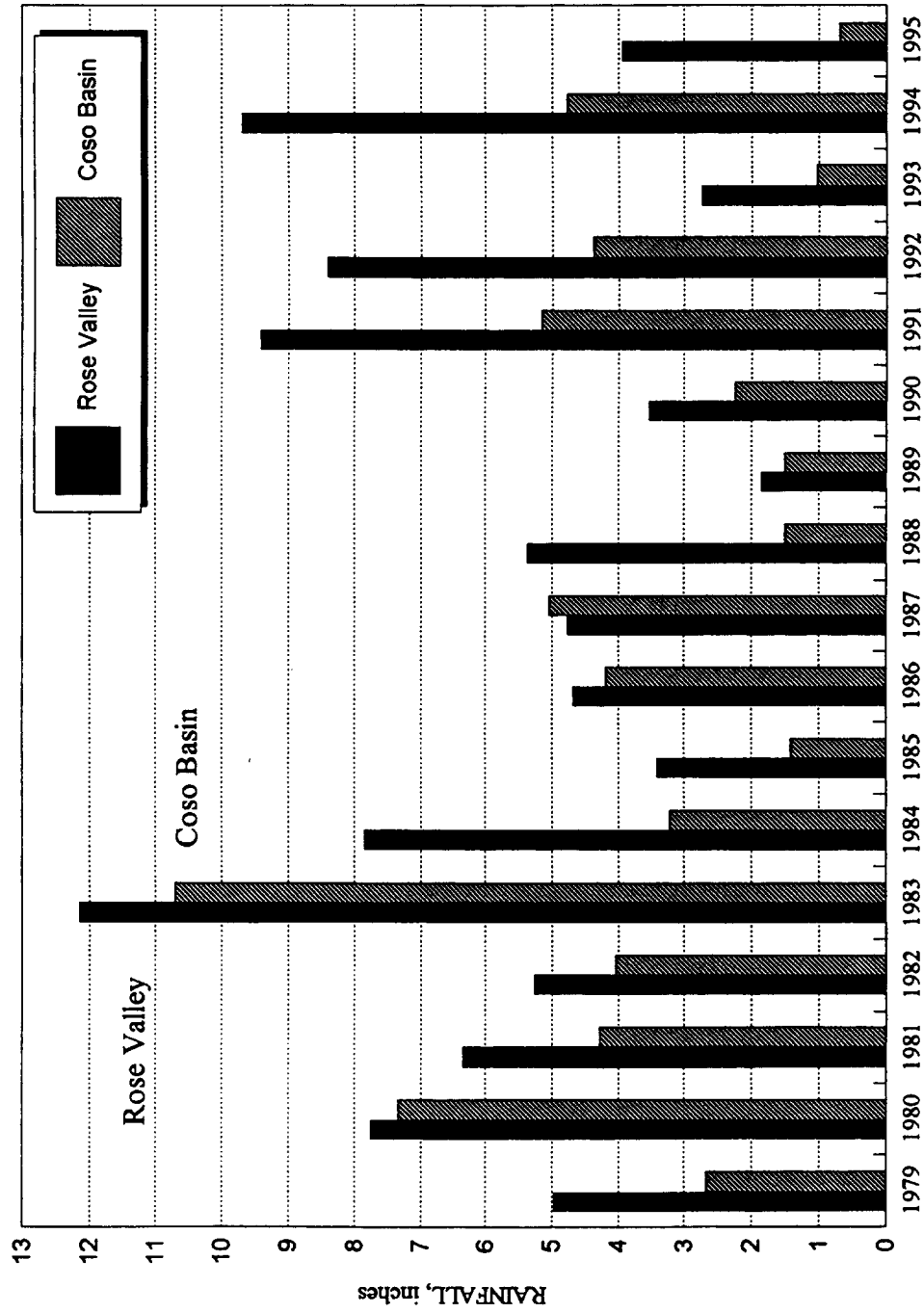


FIGURE 18. Comparison of Total Rainfall at Coso Basin and Rose Valley, 1979 Through 1995.

TABLE 6. IWV, Rose Valley, and Coso Basin Rainfall.

Year	IWV	Rose Valley	Coso Basin
1967	4.28	4.32	
1968	3.16	3.26	
1969	5.55	8.80	
1970	3.74	6.45	
1971	1.47	2.87	
1972	1.24	1.90	
1973	2.58	4.56	
1974	7.46	9.19	
1975	1.64	2.79	
1976	3.74	8.50	
1977	4.67	8.34	
1978	10.68	12.61	
1979	5.56	4.97	2.67
1980	6.31	7.75	7.34
1981	4.49	6.34	4.28
1982	4.73	5.26	4.05
1983	10.56	12.14	10.70
1984	5.95	7.84	3.23
1985	1.29	3.42	1.42
1986	3.68	4.68	4.19
1987	4.43	4.77	5.04
1988	3.76	5.36	1.51
1989	0.94	1.85	1.51
1990	1.78	3.53	2.24
1991	7.83	9.41	5.15
1992	8.10	8.40	4.38
1993	0.94	2.83	1.04
1994	6.76	9.69	4.78
1995	7.88	3.80	0.69

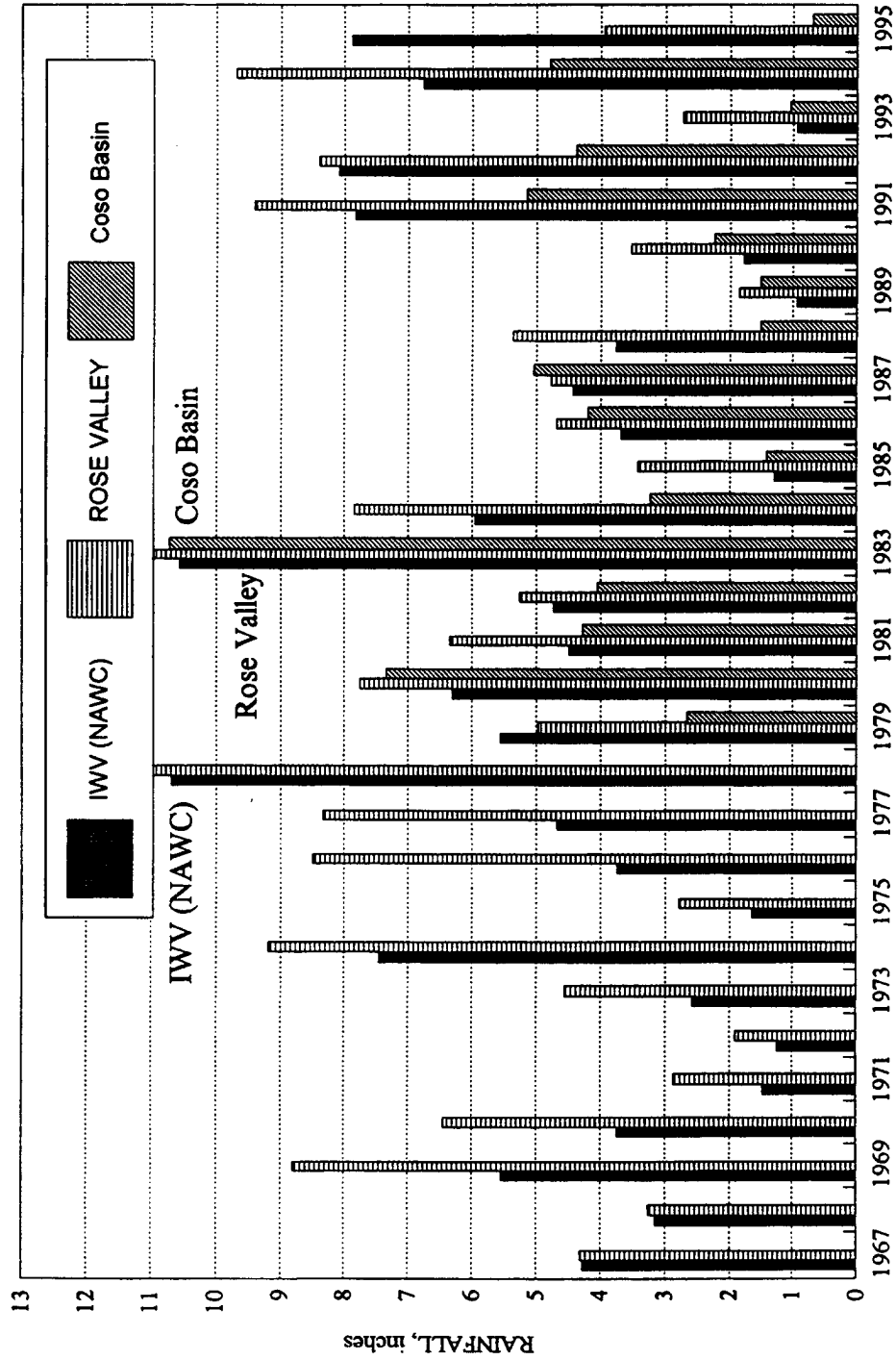


FIGURE 19. Comparison of Total Rainfall at IWV, Rose Valley, and Coso Basin Sites, 1967 Through 1995.

**COSO HOT SPRINGS MINI-WEATHER  
RECORDING STATION**

Barometric pressure, ambient temperature, relative humidity, and wind speed and wind direction are recorded at Weather Station One, located adjacent to observation well OB-1. In March 1996 this station was integrated into the base-wide weather monitoring network. During this transition the data from January 1996 through March 1996 were lost. This site is now maintained by NAWCWPNS Geophysics Operation personnel.

Barometric pressure, ambient temperature, and relative humidity were collected hourly at Weather Station One from 19 January 1994 through 30 September 1996; these data have been consolidated into a graph (Figure 20). Actual hourly data are expansive and will not be published. It is available from the Geothermal Program Office upon request.

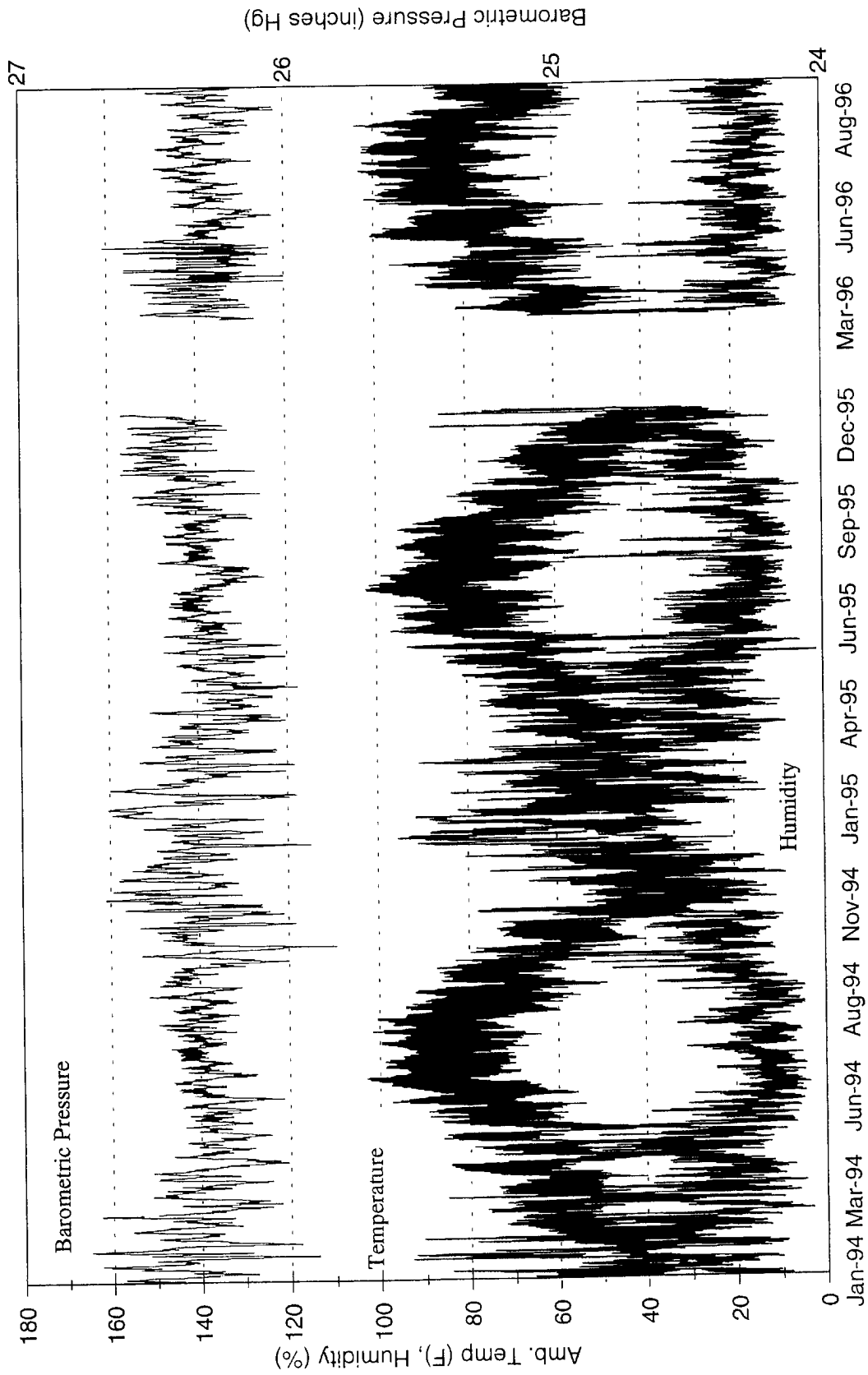


FIGURE 20. Weather Station One, Hourly Data, 19 January 1994 Through 30 September 1996.

# WATER ANALYSIS OF COSO HOT SPRINGS AREA

Water samples were collected from several sites in the Coso Hot Springs area. These samples were analyzed for a suite of geothermal constituents by NAWCWPNS' Environmental Analysis Facility. The results are provided in Table 7. Wells 4K-1, Coso No. 1 (4H-4), 4P-1, and 4K-1, as well as sites at Devils Kitchen, South Pool, West Canyon, Nichol Pool, Nichol Prospect and the West Canyon were analyzed.

TABLE 7. Chemical Analysis of Coso Area Surface and Near-Surface Thermal Waters.

Constituents	Units	4A-1 2/28/96	4K-1 2/28/96	4P-1 2/28/96	Coso Well No. 1 2/28/96	Devils Kitchen 2/28/96	Nichol Pool 2/28/96	South Pool 2/28/96	West Canyon 2/28/96
Aluminum	mg/L	a	0.06	0.07	0.31	15.2	2.54	61.4	0.22
Antimony	mg/L	a	a	a	8.80	a	a	a	a
Arsenic	mg/L	a	a	0.07	4.47	0.16	0.76	0.44	a
Barium	mg/L	0.09	a	0.11	0.09	a	0.09	a	0.06
Bicarbonate	mg/L	84.30	41.50	86.90	223	a	a	a	1.32
Boron	mg/L	0.05	0.205	0.09	1.35	3.35	49.3	9.12	0.11
Bromide	mg/L	a	0.160	0.191	3.56	a	3.42	a	a
Calcium	mg/L	27.00	3.21	92.00	3.10	55.3	48.9	148	78.5
Carbonate	mg/L	0.269	0.854	0.290	1520	a	a	a	a
Chloride	mg/L	2.00	4.27	18.9	881	3.34	1140	5.16	6.51
Conductivity	µmhos/cm	350	238	1400	18400	5180	5060	3070	1250
Copper	mg/L	a	a	a	a	a	0.05	0.55	a
Fluoride	mg/L	0.04	1.29	a	69.00	a	0.086	a	0.158
Hydroxide	mg/L	0.012	0.008	0.012	25.388	0.000	0.000	0.000	0.000
Iron	mg/L	0.09	1.66	0.99	0.14	51.50	30.5	141	2.98
Lithium	mg/L	a	0.06	0.08	51.5	0.08	3.59	0.11	0.05
Magnesium	mg/L	0.13	0.12	0.83	a	21.4	8.05	64.00	13.2
Manganese	mg/L	0.06	a	0.46	a	1.44	1.16	4.28	3.02
Mercury	mg/L	a	0.00109	0.00438	a	a	0.00115	a	0.00067
pH	pH units	7.84	7.65	7.86	11.17	2.00	2.40	2.50	4.94
Potassium	mg/L	2.33	7.19	80.00	270	32.5	115	24.2	30.3
Selenium	mg/L	0.05	1.41	0.05	1.92	a	0.903	a	a
Silica	mg/L	84.2	118	125	3340	277	316	241	263
Sodium	mg/L	54.8	41.9	163	3860	37	720	41.00	108
Strontium	mg/L	0.33	a	1.36	0.89	0.08	0.16	0.06	0.20
Sulfate	mg/L	98.3	63.3	532	1510	1110	478	1880	557
TDS	mg/L	327	429	1460	14900	1640	2980	2930	1160
Thallium	mg/L	a	a	a	0.04	a	a	a	a
Zinc	mg/L	a	0.15	0.35	2.76	0.14	0.15	1.34	0.12

<sup>a</sup> None detected.



**TEMPERATURE RECORDINGS OF THE COSO RESORT AREA WELLS**

The temperature logs from Wells 4K-1, 4P-1, and Coso No. 1 are graphed in Figure 21, with the data listed in Tables 8 through 10. These data were recorded using the TD Probe System, manufactured by Natural Progress Instruments, Dallas, Texas.

TABLE 8. Temperature Recordings at Well 4K-1.

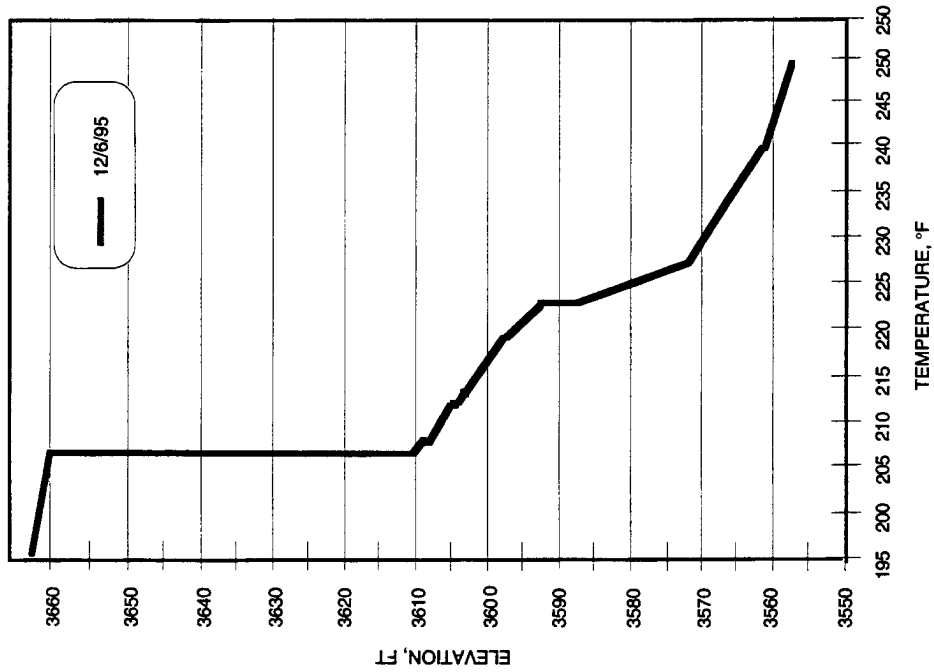
Depth, ft	Elevation, ft AMSL	Temperature °F on 12/06/96
0	3658	206.0
-5	3653	206.0
-10	3648	206.0
-15	3643	206.0
-20	3638	206.0
-25	3633	206.0
-30	3628	206.0
-35	3623	206.0
-40	3618	206.0
-45	3613	206.0
-50	3608	206.0
-51	3607	206.0
-52	3606	206.0
-53	3605	207.9
-54	3604	208.9
-55	3603	208.9
-60	3598	211.0
-65	3593	211.0
-70	3588	211.0
-75	3583	212.1
-80	3578	212.1

TABLE 9. Temperature Recordings at Well 4P-1.

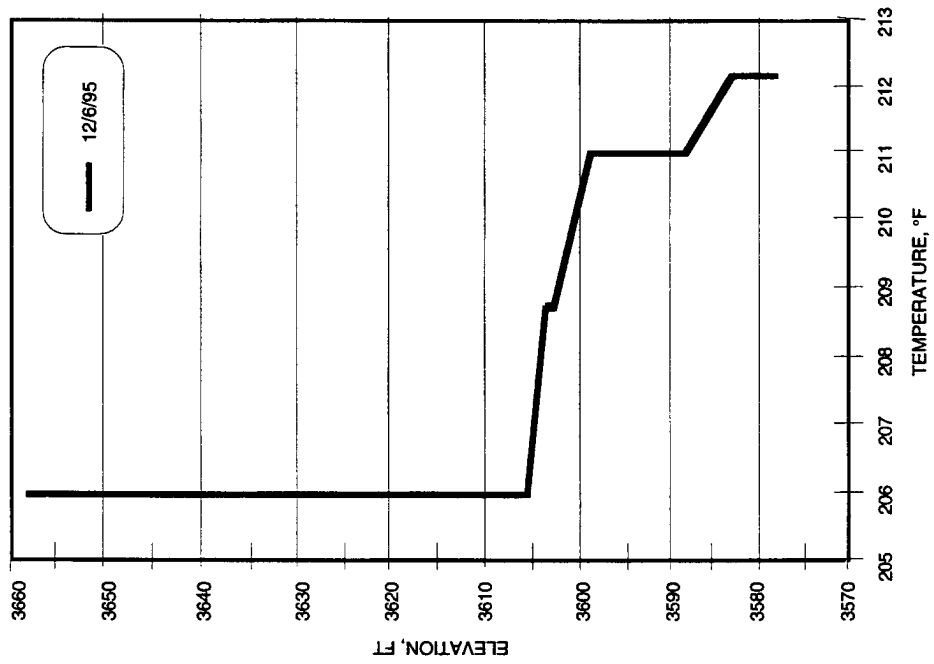
Depth, ft	Elevation, ft AMSL	Temperature °F on 12/6/96
0	3662	195.7
-5	3657	205.8
-10	3652	205.8
-15	3647	205.8
-20	3642	205.8
-25	3637	205.8
-30	3632	205.8
-35	3627	205.8
-40	3622	205.8
-45	3617	205.8
-50	3612	205.8
-51	3611	205.8
-52	3610	206.9
-53	3609	207.9
-54	3608	207.9
-55	3607	208.9
-56	3606	211.0
-57	3605	211.0
-58	3604	212.1
-59	3603	212.1
-60	3602	213.2
-65	3597	219.0
-70	3592	222.8
-75	3587	222.8
-80	3582	224.2
-85	3577	225.5
-90	3572	226.9
-95	3567	234.7
-100	3562	239.9
-102	3560	243.7
-105	3557	249.9

TABLE 10. Temperature Recordings at Coso No. 1.

Depth, ft	Elevation, ft AMSL	Temperature °F on 12/6/96
0	3615	251.5
-10	3605	251.5
-20	2595	251.5
-30	2585	252.0
-40	2575	252.0
-50	2565	252.0
-60	2555	252.0
-70	2545	252.0
-80	2535	252.1
-90	2525	252.1
-100	2515	252.1
-110	2505	252.1
-120	2495	252.1
-130	2485	252.2
-140	2475	252.2
-150	2465	252.2
-160	2455	252.2
-170	2445	252.2
-180	2435	252.2
-190	2425	252.3
-200	2415	252.3
-210	2405	252.3
-220	2395	252.3
-230	2385	252.4
-240	2375	252.4
-250	2365	252.4
-260	2355	252.4
-270	2345	252.4
-280	2335	252.4
-290	2325	252.4
-300	2315	252.4
-305	2310	252.4
-310	2305	252.4
-315	2300	252.4
-320	2295	255.8
-321	2294	257.3
-322	2293	257.7
-323	2292	258.8
-324	2291	259.0
-325	2290	259.4
-326	2289	259.6
-327	2288	259.9
-328	2287	260.1
-329	2286	260.1
-330	2285	260.7
-331	2284	261.0
-332	2283	261.3
-335	2282	261.9
-340	2281	263.0
-345	2276	264.3
-350	2271	264.9
-355	2266	265.4
-356	2267	265.8

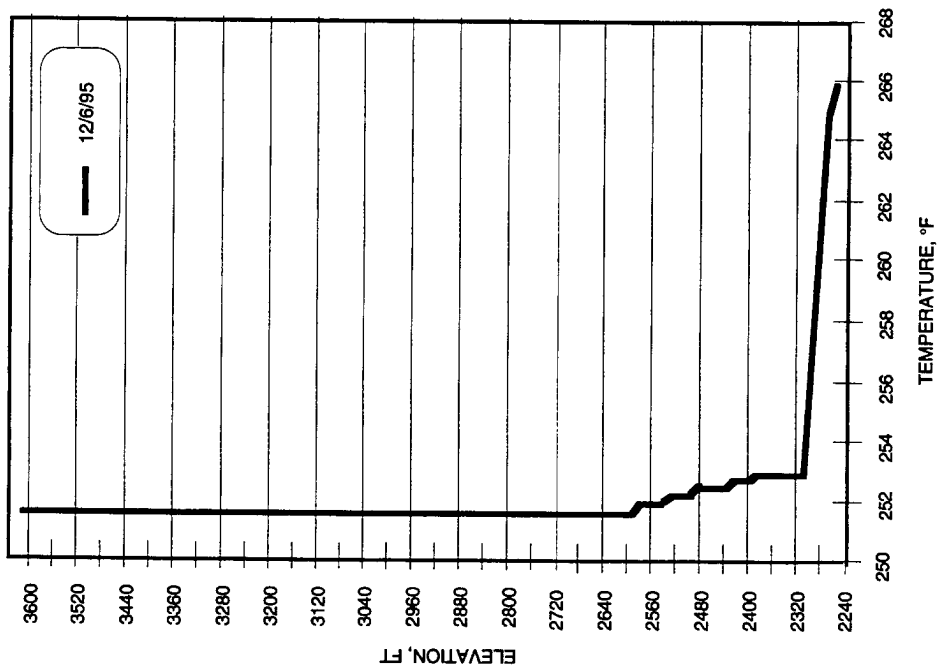


b. Well 4P-1 Temperature Gradient Log.



a. Well 4K-1 Temperature Gradient Log.

FIGURE 21. Temperature Profiles.



c. Coso No. 1 Temperature Gradient Log.

FIGURE 21. (Contd.)

## **OTHER GEOTHERMAL ACTIVITY AT COSO HOT SPRINGS**

### **WEST CANYONS**

The two west canyons are located approximately 0.7 km west of the Coso Resort area and on a course perpendicular to the strike-slip fault that runs north and south through the Coso Hot Springs area (Figure 1).

The southerly canyon (Figure 9), which has rain station No. 2 located at the west end, consists of hydrothermal alteration and scattered thermal activity both in the canyon and a wide area at the mouth of the canyon. The geology of this canyon indicates an extensive period of thermal activity, as well as historic fluctuation of these thermal features. The prominent area of activity in the canyon includes an active steam vent bordering a vigorously boiling pool. At a greater distance up the canyon are two diminutive steam vents, small springs and fossil hot spring terrace deposits. Thermal activity in these areas is sporadic, depending upon climatic conditions. No notable changes in the level of thermal activity have occurred here during this reporting period.

The northerly west canyon (Figures 10, 11) holds an extensive area of hydrothermal alteration and fossil hot spring deposits. Present thermal activity is limited to warm-to-hot ground with a small number of steam vents. The earth slump, first noted in NAWS-CL TP 001, has continued to stabilize during the past year. Much of the slump area is warm-to-hot, with steam emanating from multiple vents, specifically along the face of the slump. The small pools of mud and steam condense, noted in last years summary, are still present to the west of the slump.

One of the indicators of newly heated ground is the die-off of vegetation. The distribution of plant life in these canyons has stayed essentially unchanged. As a whole, these sites appear to be unchanged from last year.

## DISCUSSION AND SUMMARY

The data recovered from each of the steam flow monitoring sites: Devils Kitchen, Well 4H-4, and Schober's Resort are considerably less erratic this year than the data recovered in the past several years. This may be due to the new recording equipment and a formal periodic maintenance and calibration schedule, although this apparent stability could also be due to a stabilization of the thermal flux in the hot springs area. Continued monitoring of these sites may better define this issue.

The water level in well 4P-1 slowly continues to rise—about 21 feet since the beginning of the monitoring program in 1978. Most of this water level rise has occurred since 1989. The water in this well is predominately a steam condensate and probably represents a small perched water table.

In contrast to well 4P-1, the water level in well OB-1 continues to drop slightly. Well OB-1 is located adjacent to the south side of Coso Wash and is clearly set in valley fill sediments, so it is unclear why the level has dropped some 40 feet since 1988. While water analyses indicate a partial geothermal fluid component, the predominant water source is clearly inflow of meteoric water from the mountains to the north and east. The groundwater around well OB-1 may still be responding to relatively low rainfall conditions in the region from 1985 through 1990, or the groundwater may just be seeking equilibrium with groundwater on the north side of the wash (represented by well OB-2).

As discussed in previous monitoring reports, the water level in Coso No. 1 is clearly influenced by the thermal activity along the hot springs fault. The level has dropped about 175 feet since 1984 due to a significant influx of heat and boiling-off of water. Since the wellhead was repaired and the well shut in, the water level appears to have stabilized.

There has been no significant change in thermal activity at the South Pool this past year. The water level continues to fluctuate seasonally, as does the water temperature, which exhibits about a fifteen degree (F) seasonal variation.

### Additional observations:

During this reporting period, the central Coso Fault thermal area has remained very stable. The thermal area includes the old corrosion array, the Coso Resort mudfield, the South Pool, and the smaller pool and pots in between. No new mud pots have appeared here and the existing mud pots, craters, and fumaroles have not changed in appearance.

The surface ground temperatures at previously recognized hot spots both around the Upper Coso Wash Valley and along the periphery of the Coso Fault system have remained stable during the monitoring period. A hot spot is identified by warm-to-hot near-surface temperatures, discolored (cooked) soil, and/or die-off of vegetation. The shallow-rooted grasses, scrubs and deep-rooted creosote bushes that grew in these hot spots have remained the same since the last monitoring period. Some specific vegetation recovery areas are: along the fault line North of

Schober's Resort, in the northerly west canyon, around and south of well 4P-1, and in several areas in the valley east of Schober's Resort.

This year's data, particularly data obtained from the surface pools, pots, fumaroles, and hot spots, indicate seasonal fluctuation in temperatures and water levels; however, no significant increase or decrease of activity is occurring or has occurred during this monitoring period. Continuance of this monitoring program will enable us to determine if this stable trend continues.



**REFERENCES**

1. Naval Air Weapons Station. *Coso Monitoring Program, October 1993 Through September 1994*, by S. C. Bjornstad, Public Works Department, J. H. Monahan, J. K. Sprouse and D. M. White, Comarco Weapons Support Division, Ridgecrest, Calif. China Lake, Calif., NAWS-CL, January 1995. 106 pp. (NAWS-CL TP 006, publication UNCLASSIFIED.)
2. \_\_\_\_\_. *Coso Monitoring Program, October 1991 Through September 1992*, by J. H. Monahan and K. L. Larson, Comarco Weapons Support Division, Ridgecrest, Calif. China Lake, Calif., NAWS-CL, December 1992. 123 pp. (NAWS-CL TP 001, publication UNCLASSIFIED.)

**Appendix**

**DAILY STEAM FLOW**

NAWS-CL TP 008

Devils Kitchen Steam Flow 10/95 through 9/96					Well 4H-4 Steam Flow 10/95 through 9/96					Schober's Steam Flow 10/95 through 9/96				
DATE	High, lb/h	Low, lb/h	Avg, lb/h		DATE	High, lb/h	Low, lb/h	Avg, lb/h		DATE	High, lb/h	Low, lb/h	Avg, lb/h	
10/01/95	511	492	498		10/01/95	296	278	283		10/01/95	930	919	926	
10/02/95	509	481	494		10/02/95	288	270	278		10/02/95	935	924	929	
10/03/95	529	497	515		10/03/95	333	279	304		10/03/95	960	930	941	
10/04/95	519	480	496		10/04/95	323	269	290		10/04/95	953	925	934	
10/05/95	504	482	493		10/05/95	275	262	268		10/05/95	929	922	925	
10/06/95	524	496	509		10/06/95	310	272	289		10/06/95	937	921	929	
10/07/95	515	496	507		10/07/95	304	279	297		10/07/95	936	929	934	
10/08/95	508	490	498		10/08/95	291	274	281		10/08/95	940	929	934	
10/09/95	500	487	494		10/09/95	285	270	280		10/09/95	939	930	934	
10/10/95	529	480	490		10/10/95	283	267	275		10/10/95	939	927	932	
10/11/95	508	493	499		10/11/95	300	281	290		10/11/95	938	927	932	
10/12/95	502	481	495		10/12/95	299	277	292		10/12/95	938	929	934	
10/13/95	489	469	478		10/13/95	278	261	269		10/13/95	933	924	929	
10/14/95	491	474	481		10/14/95	282	263	270		10/14/95	931	924	928	
10/15/95	508	484	494		10/15/95	300	274	285		10/15/95	940	924	932	
10/16/95	502	492	497		10/16/95	303	292	299		10/16/95	940	933	938	
10/17/95	495	474	488		10/17/95	292	282	286		10/17/95	945	931	937	
10/18/95	496	481	489		10/18/95	286	277	283		10/18/95	945	933	938	
10/19/95	482	464	473		10/19/95	277	259	265		10/19/95	938	926	932	
10/20/95	496	470	483		10/20/95	297	259	278		10/20/95	938	926	930	
10/21/95	517	493	498		10/21/95	348	295	320		10/21/95	960	931	944	
10/22/95	508	467	474		10/22/95	332	265	283		10/22/95	953	913	925	
10/23/95	485	464	473		10/23/95	280	262	269		10/23/95	922	913	917	
10/24/95	491	469	481		10/24/95	282	272	275		10/24/95	922	910	917	
10/25/95	494	479	484		10/25/95	289	277	281		10/25/95	926	912	919	
10/26/95	499	482	490		10/26/95	299	279	288		10/26/95	940	919	928	
10/27/95	500	488	495		10/27/95	303	292	296		10/27/95	946	933	939	
10/28/95	499	491	495		10/28/95	299	292	296		10/28/95	946	939	945	
10/29/95	495	481	490		10/29/95	296	283	291		10/29/95	946	939	944	
10/30/95	495	477	486		10/30/95	299	281	287		10/30/95	946	939	945	
10/31/95	498	480	490		10/31/95	337	290	296		10/31/95	948	937	946	
11/01/95	491	472	480		11/01/95	296	263	280		11/01/95	951	941	946	
11/02/95	478	467	473		11/02/95	274	258	265		11/02/95	948	939	944	
11/03/95	484	471	478		11/03/95	282	261	270		11/03/95	948	939	944	
11/04/95	485	476	481		11/04/95	281	269	274		11/04/95	948	939	944	
11/05/95	498	478	486		11/05/95	293	269	280		11/05/95	950	939	944	
11/06/95	494	472	484		11/06/95	292	257	280		11/06/95	948	939	945	
11/07/95	522	462	474		11/07/95	294	244	254		11/07/95	943	932	936	
11/08/95	502	477	489		11/08/95	300	259	279		11/08/95	975	939	956	
11/09/95	521	471	489		11/09/95	334	299	314						

NAWS-CL TP 008

Devils Kitchen Steam Flow 10/95 through 9/96					Well 4H-4 Steam Flow 10/95 through 9/96					Schober's Steam Flow 10/95 through 9/96				
DATE	High, lb/h	Low, lb/h	Avg, lb/h		DATE	High, lb/h	Low, lb/h	Avg, lb/h		DATE	High, lb/h	Low, lb/h	Avg, lb/h	
11/10/95	505	460	478		11/10/95	313	237	273		11/10/95	970	927	948	
11/11/95	485	460	472		11/11/95	262	235	248		11/11/95	936	925	931	
11/12/95	493	479	485		11/12/95	283	260	268		11/12/95	945	927	935	
11/13/95	495	479	486		11/13/95	284	265	272		11/13/95	945	932	936	
11/14/95	503	479	487		11/14/95	305	279	289		11/14/95	966	934	946	
11/15/95	497	479	487		11/15/95	292	279	287		11/15/95	954	945	950	
11/16/95	491	478	485		11/16/95	279	262	273		11/16/95	952	945	947	
11/17/95	492	475	483		11/17/95	267	258	263		11/17/95	947	938	944	
11/18/95	497	479	487		11/18/95	290	264	275		11/18/95	950	938	944	
11/19/95	497	480	487		11/19/95	290	271	282		11/19/95	950	941	946	
11/20/95	491	475	483		11/20/95	272	259	265		11/20/95	947	938	944	
11/21/95	503	478	490		11/21/95	294	264	273		11/21/95	951	936	952	
11/22/95	492	478	487		11/22/95	280	277	279		11/22/95	956	945	950	
11/23/95	491	478	485		11/23/95	278	263	269		11/23/95	949	938	945	
11/24/95	496	478	487		11/24/95	271	263	266		11/24/95	949	938	943	
11/25/95	503	484	493		11/25/95	300	267	283		11/25/95	956	940	948	
11/26/95	502	483	487		11/26/95	313	271	293		11/26/95	954	940	948	
11/27/95	491	478	487		11/27/95	275	258	266		11/27/95	945	931	936	
11/28/95	492	478	487		11/28/95	309	257	262		11/28/95	943	929	936	
11/29/95	500	484	493		11/29/95	271	256	262		11/29/95	942	931	936	
11/30/95	503	489	496		11/30/95	290	268	279		11/30/95	945	933	938	
12/01/95	503	484	493		12/01/95	306	285	292		12/01/95	951	938	942	
12/02/95	496	483	489		12/02/95	289	257	274		12/02/95	945	931	941	
12/03/95	497	484	490		12/03/95	271	254	260		12/03/95	942	931	935	
12/04/95	500	484	493		12/04/95	281	261	268		12/04/95	945	931	937	
12/05/95	497	484	487		12/05/95	284	267	274		12/05/95	947	931	939	
12/06/95	497	487	492		12/06/95	276	270	273		12/06/95	945	933	940	
12/07/95	503	489	496		12/07/95	284	259	278		12/07/95	945	933	940	
12/08/95	496	484	487		12/08/95	260	253	256		12/08/95	942	931	936	
12/09/95	496	483	482		12/09/95	262	248	254		12/09/95	938	926	932	
12/10/95	497	483	489		12/10/95	269	247	257		12/10/95	938	926	931	
12/11/95	497	489	493		12/11/95	285	267	276		12/11/95	938	931	933	
12/12/95	497	479	487		12/12/95	299	283	283		12/12/95	947	933	934	
12/13/95	491	478	485		12/13/95	287	271	282		12/13/95				
12/14/95	492	475	483		12/14/95	284	239	253		12/14/95				
12/15/95	497	479	487		12/15/95	303	240	273		12/15/95				
12/16/95	497	480	487		12/16/95	303	278	296		12/16/95				
12/17/95	491	475	483		12/17/95	281	276	279		12/17/95				
12/18/95	503	478	490		12/18/95	279	275	277		12/18/95				
12/19/95	492	478	487		12/19/95	287	274	279		12/19/95				
12/20/95	491	478	485		12/20/95	295	277	286		12/20/95				
12/21/95	496	478	487		12/21/95	281	267	276		12/21/95				

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Devils Kitchen Steam Flow 10/95 through 9/96					Well 4H-4 Steam Flow 10/95 through 9/96					Schober's Steam Flow 10/95 through 9/96				
DATE	High, lb/h	Low, lb/h	Avg, lb/h		DATE	High, lb/h	Low, lb/h	Avg, lb/h		DATE	High, lb/h	Low, lb/h	Avg, lb/h	
12/22/95	503	484	493		12/22/95	275	265	269		12/22/95				
12/23/95	502	483	487		12/23/95	285	269	275		12/23/95				
12/24/95	491	478	487		12/24/95	270	262	267		12/24/95				
12/25/95	500	484	493		12/25/95	285	264	272		12/25/95				
12/26/95	500	488	493		12/26/95	292	277	283		12/26/95				
12/27/95	501	488	494		12/27/95	303	285	291		12/27/95	933	928	932	
12/28/95	498	486	491		12/28/95	303	281	296		12/28/95	937	925	931	
12/29/95	497	488	493		12/29/95	295	276	284		12/29/95	930	922	927	
12/30/95	503	484	493		12/30/95	295	288	293		12/30/95	935	924	930	
12/31/95	499	483	491		12/31/95	319	283	298		12/31/95	941	928	933	
01/01/96	496	484	491		01/01/96	291	277	284		01/01/96	934	915	924	
01/02/96	500	488	494		01/02/96	289	277	284		01/02/96	926	910	919	
01/03/96	509	500	505		01/03/96	334	280	309		01/03/96	939	914	931	
01/04/96	508	488	499		01/04/96	331	290	315		01/04/96	947	935	942	
01/05/96	496	485	491		01/05/96	291	262	284		01/05/96	940	923	933	
01/06/96	491	479	485		01/06/96	264	251	260		01/06/96	925	915	919	
01/07/96	501	483	490		01/07/96	296	261	277		01/07/96	929	915	920	
01/08/96	503	489	495		01/08/96	302	292	297		01/08/96	928	917	922	
01/09/96	503	485	494		01/09/96	311	296	302		01/09/96	947	918	927	
01/10/96	493	479	485		01/10/96	305	264	282		01/10/96	933	899	915	
01/11/96	495	480	487		01/11/96	283	262	271		01/11/96	926	905	912	
01/12/96	508	488	499		01/12/96	316	280	297		01/12/96	910	901	903	
01/13/96	498	485	492		01/13/96	321	307	311		01/13/96	910	889	897	
01/14/96	507	488	496		01/14/96	309	295	301		01/14/96	894	886	887	
01/15/96	497	484	491		01/15/96	324	293	306		01/15/96	899	889	892	
01/16/96	492	479	486		01/16/96	362	318	336		01/16/96	896	880	886	
01/17/96	494	480	487		01/17/96	360	269	315		01/17/96	887	873	878	
01/18/96	498	479	491		01/18/96	299	265	278		01/18/96	879	873	873	
01/19/96	497	478	489		01/19/96	310	271	298		01/19/96	887	873	876	
01/20/96	495	478	487		01/20/96	280	257	268		01/20/96	879	862	866	
01/21/96	504	487	494		01/21/96	329	280	312		01/21/96	894	866	873	
01/22/96	503	485	494		01/22/96	325	265	297		01/22/96	894	886	887	
01/23/96	493	479	485		01/23/96	273	255	264		01/23/96	894	886	887	
01/24/96	495	480	487		01/24/96	316	273	296		01/24/96	891	886	886	
01/25/96	508	488	499		01/25/96	328	284	319		01/25/96	891	886	886	
01/26/96	498	485	492		01/26/96	284	269	274		01/26/96	894	886	887	
01/27/96	510	490	500		01/27/96	322	273	301		01/27/96	894	887	889	
01/28/96	503	489	497		01/28/96	321	290	300		01/28/96	923	889	900	
01/29/96	509	495	499		01/29/96	310	291	298		01/29/96	930	920	922	
01/30/96	508	495	502		01/30/96	313	298	305		01/30/96	929	923	923	
01/31/96	508	498	503		01/31/96	334	311	320		01/31/96	935	923	926	
02/01/96	510	500	505		02/01/96	329	303	317		02/01/96	973	964	965	

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Devils Kitchen Steam Flow 10/95 through 9/96					Well 4H-4 Steam Flow 10/95 through 9/96					Schober's Steam Flow 10/95 through 9/96				
DATE	High, lb/h	Low, lb/h	Avg, lb/h		DATE	High, lb/h	Low, lb/h	Avg, lb/h		DATE	High, lb/h	Low, lb/h	Avg, lb/h	
02/02/96	507	488	496		02/02/96	303	260	287		02/02/96	976	967	968	
02/03/96	497	484	491		02/03/96	266	248	258		02/03/96	976	967	968	
02/04/96	503	489	496		02/04/96	282	256	267		02/04/96	973	967	967	
02/05/96	506	492	500		02/05/96	286	269	275		02/05/96	976	967	968	
02/06/96	509	495	500		02/06/96	295	274	282		02/06/96	976	967	968	
02/07/96	513	501	508		02/07/96	318	287	300		02/07/96	974	968	968	
02/08/96	520	505	512		02/08/96	328	299	311		02/08/96	974	968	968	
02/09/96	519	507	513		02/09/96	321	307	316		02/09/96	973	967	967	
02/10/96	514	502	507		02/10/96	308	283	296		02/10/96	973	967	967	
02/11/96	515	500	506		02/11/96	301	281	287		02/11/96	973	967	967	
02/12/96	514	501	507		02/12/96	305	279	292		02/12/96	973	967	967	
02/13/96	516	501	507		02/13/96	305	277	288		02/13/96	973	967	967	
02/14/96	515	503	508		02/14/96	297	289	291		02/14/96	973	964	965	
02/15/96					02/15/96					02/15/96	973	964	965	
02/16/96					02/16/96					02/16/96	973	956	961	
02/17/96					02/17/96					02/17/96	973	956	962	
02/18/96					02/18/96					02/18/96	989	964	972	
02/19/96					02/19/96					02/19/96	970	951	958	
02/20/96					02/20/96					02/20/96	957	939	945	
02/21/96	510	501	505		02/21/96	309	294	319		02/21/96	946	936	939	
02/22/96	514	491	505		02/22/96	313	250	288		02/22/96	941	936	936	
02/23/96	519	492	505		02/23/96	307	248	275		02/23/96	941	929	933	
02/24/96	532	512	521		02/24/96	361	306	336		02/24/96	937	928	929	
02/25/96	529	512	520		02/25/96	347	324	334		02/25/96	937	928	929	
02/26/96	520	502	510		02/26/96	330	278	304		02/26/96	941	928	931	
02/27/96	514	502	507		02/27/96	291	277	283		02/27/96	943	934	936	
02/28/96	514	500	506		02/28/96	288	268	279		02/28/96	949	936	940	
02/29/96	509	497	503		02/29/96	274	260	268		02/29/96	934	920	925	
03/01/96	514	498	494		03/01/96	292	260	274		03/01/96	929	920	922	
03/02/96	515	504	510		03/02/96	326	288	308		03/02/96	937	922	928	
03/03/96	526	512	518		03/03/96	339	318	328		03/03/96	941	928	933	
03/04/96	526	510	517		03/04/96	342	324	337		03/04/96	945	936	937	
03/05/96	529	512	520		03/05/96	355	315	330		03/05/96	945	936	937	
03/06/96	508	489	499		03/06/96	315	277	292		03/06/96	945	928	934	
03/07/96	515	497	505		03/07/96	325	277	301		03/07/96	934	923	925	
03/08/96	521	505	513		03/08/96	346	316	329		03/08/96	937	920	926	
03/09/96	518	507	512		03/09/96	342	327	335		03/09/96	941	931	934	
03/10/96	521	508	514		03/10/96	358	334	343		03/10/96	938	920	926	
03/11/96	520	509	515		03/11/96	366	334	351		03/11/96	934	914	920	
03/12/96	526	512	520		03/12/96	397	364	381		03/12/96	918	905	908	
03/13/96	504	494	499		03/13/96	397	337	377		03/13/96	918	905	908	
03/14/96	504	494	499		03/14/96	337	308	325		03/14/96	926	912	915	

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Devils Kitchen Steam Flow 10/95 through 9/96					Well 4H-4 Steam Flow 10/95 through 9/96					Schober's Steam Flow 10/95 through 9/96				
DATE	High, lb/h	Low, lb/h	Avg, lb/h		DATE	High, lb/h	Low, lb/h	Avg, lb/h		DATE	High, lb/h	Low, lb/h	Avg, lb/h	
03/15/96	520	495	506		03/15/96	349	308	327		03/15/96	941	925	929	
03/15/96	524	507	514		03/16/96	362	336	347		03/16/96	941	929	934	
03/17/96	526	507	516		03/17/96	381	337	357		03/17/96	943	931	936	
03/18/96	516	501	509		03/18/96	368	347	358		03/18/96	943	931	934	
03/19/96	514	500	507		03/19/96	374	355	362		03/19/96	957	920	936	
03/20/96	519	499	509		03/20/96	392	362	371		03/20/96	946	920	931	
03/21/96	530	514	520		03/21/96	406	373	386		03/21/96	946	937	939	
03/22/96	532	513	523		03/22/96	409	392	404		03/22/96	949	928	936	
03/23/96	522	500	510		03/23/96	407	342	377		03/23/96	941	926	928	
03/24/96	520	499	510		03/24/96	371	338	350		03/24/96	932	904	915	
03/25/96	530	489	514		03/25/96	405	328	370		03/25/96	947	885	925	
03/26/96	516	489	505		03/26/96	355	325	338		03/26/96	931	885	908	
03/27/96	529	504	516		03/27/96	394	352	372		03/27/96	943	920	931	
03/28/96	534	501	522		03/28/96	420	353	393		03/28/96	965	923	945	
03/29/96	517	507	512		03/29/96	353	329	337		03/29/96	932	919	926	
03/30/96	543	507	516		03/30/96	364	335	346		03/30/96	940	925	931	
03/31/96	546	507	513		03/31/96	381	353	363		03/31/96	948	931	937	
04/01/96	532	506	510		04/01/96	392	368	378		04/01/96	958	937	943	
04/02/96	517	501	510		04/02/96	383	351	368		04/02/96	958	939	949	
04/03/96	532	496	516		04/03/96	368	342	353		04/03/96	951	940	947	
04/04/96	514	489	502		04/04/96	344	321	333		04/04/96	944	916	926	
04/05/96	515	495	505		04/05/96	351	328	335		04/05/96	928	906	920	
04/06/96	521	501	510		04/06/96	394	335	361		04/06/96	949	921	935	
04/07/96	523	507	516		04/07/96	397	373	381		04/07/96	966	942	952	
04/08/96	526	507	513		04/08/96	375	355	367		04/08/96	961	948	957	
04/09/96	526	507	516		04/09/96	390	352	368		04/09/96	961	948	954	
04/10/96	534	502	523		04/10/96	404	376	386		04/10/96	969	947	955	
04/11/96	530	500	516		04/11/96	377	339	359		04/11/96	951	912	930	
04/12/96	529	498	513		04/12/96	404	356	377		04/12/96	957	931	940	
04/13/96	518	500	507		04/13/96	356	339	346		04/13/96	931	915	922	
04/14/96	510	495	505		04/14/96	352	330	340		04/14/96	921	902	915	
04/15/96	525	501	512		04/15/96	401	345	369		04/15/96	942	910	925	
04/16/96	526	507	516		04/16/96	400	373	390		04/16/96	938	920	931	
04/17/96	532	507	525		04/17/96	376	355	372		04/17/96	935	915	922	
04/18/96	523	495	510		04/18/96	358	324	348		04/18/96	922	902	916	
04/19/96	523	495	507		04/19/96	378	321	344		04/19/96	925	902	911	
04/20/96	521	502	513		04/20/96	383	369	375		04/20/96	923	908	917	
04/21/96	520	501	510		04/21/96	381	344	369		04/21/96	926	912	919	
04/22/96	514	500	510		04/22/96	352	333	341		04/22/96	922	907	915	
04/23/96	521	501	510		04/23/96	372	340	351		04/23/96	925	906	915	
04/24/96	526	498	516		04/24/96	394	359	368		04/24/96	936	919	921	
04/25/96	520	498	513		04/25/96	370	347	358		04/25/96	950	924	933	

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Devils Kitchen Steam Flow 10/95 through 9/96					Well 4H-4 Steam Flow 10/95 through 9/96					Schober's Steam Flow 10/95 through 9/96				
DATE	High, lb/h	Low, lb/h	Avg, lb/h		DATE	High, lb/h	Low, lb/h	Avg, lb/h		DATE	High, lb/h	Low, lb/h	Avg, lb/h	
04/26/96	530	501	516		04/26/96	385	347	369		04/26/96	956	930	939	
04/27/96	526	507	513		04/27/96	394	370	382		04/27/96	955	932	944	
04/28/96	514	495	505		04/28/96	370	323	341		04/28/96	936	891	909	
04/29/96	526	496	507		04/29/96	366	320	339		04/29/96	927	901	910	
04/30/96	526	507	516		04/30/96	396	359	374		04/30/96	937	913	924	
05/01/96	531	498	510		05/01/96	379	371	375		05/01/96	934	926	928	
05/02/96	526	496	509		05/02/96	387	377	396		05/02/96	945	942	952	
05/03/96	529	507	513		05/03/96	393	365	378		05/03/96	959	940	945	
05/04/96	520	502	510		05/04/96	371	350	360		05/04/96	946	926	937	
05/05/96	523	497	510		05/05/96	378	348	358		05/05/96	945	926	933	
05/06/96	526	507	516		05/06/96	389	360	370		05/06/96	953	928	937	
05/07/96	525	507	513		05/07/96	381	363	371		05/07/96	946	931	939	
05/08/96	520	507	513		05/08/96	363	359	360		05/08/96	937	926	931	
05/09/96	516	494	505		05/09/96	284	262	280		05/09/96	931	926	929	
05/10/96	519	500	505		05/10/96	285	262	280		05/10/96	929	924	926	
05/11/96	517	501	509		05/11/96	281	272	275		05/11/96	931	926	928	
05/12/96	519	496	507		05/12/96	287	275	281		05/12/96	944	930	936	
05/13/96	520	501	510		05/13/96	302	286	292		05/13/96	947	940	943	
05/14/96	526	507	516		05/14/96	303	293	296		05/14/96	944	941	942	
05/15/96	526	509	516		05/15/96	295	290	293		05/15/96	942	935	939	
05/16/96	520	507	513		05/16/96	293	287	290		05/16/96	936	929	932	
05/17/96	517	501	510		05/17/96	292	283	287		05/17/96	934	929	931	
05/18/96	520	501	511		05/18/96	292	282	285		05/18/96	935	928	931	
05/19/96	517	501	510		05/19/96	296	285	290		05/19/96	937	929	932	
05/20/96	516	499	507		05/20/96	295	286	290		05/20/96	936	931	933	
05/21/96	515	503	509		05/21/96	290	283	286		05/21/96	936	933	934	
05/22/96	523	496	509		05/22/96	293	287	290		05/22/96	942	928	935	
05/23/96	525	497	511		05/23/96	300	286	292		05/23/96	941	923	929	
05/24/96	519	501	510		05/24/96	299	282	287		05/24/96	932	923	926	
05/25/96	518	501	509		05/25/96	295	285	291		05/25/96	930	922	926	
05/26/96	517	500	509		05/26/96	289	280	285		05/26/96	936	925	929	
05/27/96	520	489	505		05/27/96	292	280	286		05/27/96	946	928	936	
05/28/96	508	488	498		05/28/96	306	286	295		05/28/96	937	925	930	
05/29/96	518	497	507		05/29/96	293	280	286		05/29/96	943	935	938	
05/30/96	514	501	507		05/30/96	298	290	293		05/30/96	942	937	938	
05/31/96	511	499	505		05/31/96	292	283	289		05/31/96	938	934	936	
06/01/96	517	504	510		06/01/96	287	280	283		06/01/96	936	933	935	
06/02/96	518	492	503		06/02/96	282	276	279		06/02/96	941	933	936	
06/03/96	514	495	505		06/03/96	286	276	280		06/03/96	950	939	943	
06/04/96	513	500	506		06/04/96	296	282	288		06/04/96	956	947	951	
06/05/96	520	502	508		06/05/96	300	290	295		06/05/96	954	942	947	
06/06/96	520	500	507		06/06/96	298	290	294		06/06/96	945	939	942	



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Devils Kitchen Steam Flow 10/95 through 9/96					Well 4H-4 Steam Flow 10/95 through 9/96					Schober's Steam Flow 10/95 through 9/96				
DATE	High, lb/h	Low, lb/h	Avg, lb/h		DATE	High, lb/h	Low, lb/h	Avg, lb/h		DATE	High, lb/h	Low, lb/h	Avg, lb/h	
06/07/96	519	501	510		06/07/96	294	286	290		06/07/96	942	936	939	
06/08/96	519	495	505		06/08/96	292	283	288		06/08/96	940	935	938	
06/09/96	514	501	507		06/09/96	290	285	288		06/09/96	942	936	938	
06/10/96	514	500	507		06/10/96	296	287	291		06/10/96	947	935	939	
06/11/96	516	500	508		06/11/96	300	287	292		06/11/96	946	938	941	
06/12/96	520	503	509		06/12/96	298	292	294		06/12/96	943	937	940	
06/13/96					06/13/96	294	288	291		06/13/96	940	935	937	
06/14/96					06/14/96	292	285	287		06/14/96	941	935	937	
06/15/96					06/15/96	293	285	288		06/15/96	942	935	938	
06/16/96					06/16/96	294	288	290		06/16/96	939	934	936	
06/17/96					06/17/96	293	285	289		06/17/96	939	930	934	
06/18/96					06/18/96	292	282	286		06/18/96	940	933	935	
06/19/96					06/19/96	295	285	288		06/19/96	940	932	936	
06/20/96					06/20/96	294	287	289		06/20/96	941	932	935	
06/21/96					06/21/96	298	285	290		06/21/96	945	937	940	
06/22/96					06/22/96	300	288	294		06/22/96	938	929	934	
06/23/96					06/23/96	288	282	285		06/23/96	940	933	935	
06/24/96					06/24/96	292	281	286		06/24/96	941	933	936	
06/25/96	506	495	501		06/25/96	295	286	289		06/25/96	935	933	934	
06/26/96	504	489	497		06/26/96	290	286	287		06/26/96	933	922	926	
06/27/96	504	484	494		06/27/96	289	281	286		06/27/96	923	917	920	
06/28/96	503	489	496		06/28/96	286	276	281		06/28/96	920	916	918	
06/29/96	507	489	499		06/29/96	280	274	276		06/29/96	927	917	921	
07/01/96	508	491	501		06/30/96	289	275	281		06/30/96	932	925	927	
07/02/96	508	491	500		07/01/96	290	283	285		07/01/96	939	927	931	
07/03/96	508	487	499		07/02/96	293	280	286		07/02/96	945	935	938	
07/04/96	512	495	504		07/03/96	298	288	291		07/03/96	941	938	940	
07/05/96	507	492	500		07/04/96	289	280	289		07/04/96	948	936	940	
07/06/96	504	491	499		07/05/96	296	286	290		07/05/96	945	939	941	
07/07/96	508	492	502		07/06/96	293	285	288		07/06/96	946	937	941	
07/08/96	508	494	502		07/07/96	289	281	285		07/07/96	948	941	944	
07/09/96	503	489	496		07/08/96	296	283	288		07/08/96	949	943	945	
07/10/96	503	486	494		07/09/96	295	288	291		07/09/96	945	941	943	
07/11/96	506	488	495		07/10/96	288	275	284		07/10/96	942	936	939	
07/12/96	503	488	496		07/11/96	287	270	279		07/11/96	943	933	938	
07/13/96	506	489	498		07/12/96	288	275	281		07/12/96	941	932	936	
07/14/96	503	491	497		07/13/96	292	280	285		07/13/96	942	938	940	
07/15/96	507	489	499		07/14/96	293	285	287		07/14/96	947	939	943	
07/16/96	503	481	492		07/15/96	290	285	288		07/15/96	951	942	945	
07/17/96	503	487	493		07/16/96	295	283	288		07/16/96	947	944	945	
07/18/96	503	484	494		07/17/96	296	287	290		07/17/96	947	941	943	
					07/18/96	290	279	285		07/18/96	941	936	939	

Devils Kitchen Steam Flow 10/95 through 9/96					Well 4H-4 Steam Flow 10/95 through 9/96					Schober's Steam Flow 10/95 through 9/96				
DATE	High, lb/h	Low, lb/h	Avg, lb/h		DATE	High, lb/h	Low, lb/h	Avg, lb/h		DATE	High, lb/h	Low, lb/h	Avg, lb/h	
07/19/96	502	485	494		07/19/96	286	277	280		07/19/96	944	936	939	
07/20/96	503	487	493		07/20/96	287	277	281		07/20/96	946	939	942	
07/21/96	503	489	493		07/21/96	290	282	285		07/21/96	945	941	942	
07/22/96	498	484	490		07/22/96	288	280	283		07/22/96	947	940	943	
07/23/96	503	484	494		07/23/96	286	279	281		07/23/96	952	943	946	
07/24/96	504	484	494		07/24/96	293	282	286		07/24/96	956	944	949	
07/25/96	506	489	498		07/25/96	295	285	289		07/25/96	955	946	949	
07/26/96	503	484	496		07/26/96	294	285	289		07/26/96	949	943	946	
07/27/96	497	478	487		07/27/96	288	280	284		07/27/96	947	938	941	
07/28/96	497	481	491		07/28/96	283	272	278		07/28/96	943	937	939	
07/29/96	505	481	490		07/29/96	287	275	280		07/29/96	946	939	941	
07/30/96	503	484	494		07/30/96	288	276	281		07/30/96	950	940	944	
07/31/96	504	483	493		07/31/96	295	282	287		07/31/96	953	945	949	
08/01/96	507	489	499		08/01/96	295	286	289		08/01/96	954	948	950	
08/02/96	507	489	499		08/02/96	296	277	289		08/02/96	955	949	951	
08/03/96	508	490	499		08/03/96	293	285	288		08/03/96	953	949	951	
08/04/96	509	490	499		08/04/96	295	287	290		08/04/96	950	938	941	
08/05/96	501	483	492		08/05/96	290	279	283		08/05/96	943	937	940	
08/06/96	507	487	495		08/06/96	290	277	283		08/06/96	942	936	939	
08/07/96	498	484	491		08/07/96	287	275	280		08/07/96	940	936	938	
08/08/96	500	484	492		08/08/96	281	273	277		08/08/96	942	937	939	
08/09/96	503	484	493		08/09/96	283	273	277		08/09/96	945	939	942	
08/10/96	503	487	495		08/10/96	288	274	281		08/10/96	946	942	944	
08/11/96	503	485	493		08/11/96	290	281	284		08/11/96	946	942	944	
08/12/96	503	483	492		08/12/96	289	279	282		08/12/96	946	933	942	
08/13/96	503	484	493		08/13/96	285	274	278		08/13/96	944	934	938	
08/14/96	503	484	493		08/14/96	286	274	278		08/14/96	946	940	943	
08/15/96	503	487	495		08/15/96	288	273	280		08/15/96	946	940	943	
08/16/96	503	489	496		08/16/96	289	280	283		08/16/96	947	944	945	
08/17/96	506	488	497		08/17/96	289	282	285		08/17/96	949	944	947	
08/18/96	506	489	498		08/18/96	294	282	287		08/18/96	948	945	947	
08/19/96	501	483	492		08/19/96	292	283	288		08/19/96	945	938	941	
08/20/96	503	484	493		08/20/96	285	275	279		08/20/96	942	937	940	
08/21/96	503	481	492		08/21/96	288	276	280		08/21/96	946	938	942	
08/22/96	503	487	494		08/22/96	288	275	282		08/22/96	943	939	942	
08/23/96	501	484	491		08/23/96	287	277	282		08/23/96	943	939	941	
08/24/96	504	485	494		08/24/96	288	275	279		08/24/96	947	937	942	
08/25/96	508	489	499		08/25/96	292	276	282		08/25/96	953	944	947	
08/26/96	508	491	499		08/26/96	299	285	289		08/26/96	950	948	949	
08/27/96	503	488	494		08/27/96	299	286	291		08/27/96	948	942	945	
08/28/96	497	484	491		08/28/96	290	279	284		08/28/96	942	935	937	
08/29/96	503	484	493		08/29/96	282	270	276		08/29/96	942	935	939	

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Devils Kitchen Steam Flow 10/95 through 9/96					Well 4H-4 Steam Flow 10/95 through 9/96					Schober's Steam Flow 10/95 through 9/96				
DATE	High, lb/h	Low, lb/h	Avg, lb/h		DATE	High, lb/h	Low, lb/h	Avg, lb/h		DATE	High, lb/h	Low, lb/h	Avg, lb/h	
08/30/96	506	488	494		08/30/96	287	275	279		08/30/96	947	939	943	
08/31/96	508	489	499		08/31/96	294	280	286		08/31/96	951	944	947	
09/01/96	507	489	498		09/01/96	299	287	291		09/01/96	950	947	948	
09/02/96	503	487	495		09/02/96	296	289	292		09/02/96	951	944	946	
09/03/96	503	488	496		09/03/96	295	282	286		09/03/96	945	940	942	
09/04/96	506	489	498		09/04/96	289	280	284		09/04/96	944	938	941	
09/05/96	508	489	499		09/05/96	293	276	286		09/05/96	942	939	941	
09/06/96	497	484	490		09/06/96	295	285	288		09/06/96	941	934	937	
09/07/96	501	483	491		09/07/96	285	276	280		09/07/96	937	933	935	
09/08/96	503	484	493		09/08/96	285	273	279		09/08/96	940	935	937	
09/09/96	504	485	498		09/09/96	289	276	282		09/09/96	941	937	939	
09/10/96	503	487	495		09/10/96	289	281	284		09/10/96	938	933	936	
09/11/96	508	478	493		09/11/96	288	276	281		09/11/96	942	936	938	
09/12/96	511	491	499		09/12/96	295	274	286		09/12/96	941	936	939	
09/13/96	514	495	504		09/13/96	298	285	290		09/13/96	943	937	940	
09/14/96	503	488	494		09/14/96	299	292	293		09/14/96	940	937	938	
09/15/96	510	489	501		09/15/96	290	281	288		09/15/96	944	936	939	
09/16/96	501	488	495		09/16/96	299	281	287		09/16/96	939	933	936	
09/17/96	503	481	492		09/17/96	289	272	283		09/17/96	936	927	932	
09/18/96	497	484	490		09/18/96	285	269	276		09/18/96	935	926	930	
09/19/96	506	484	498		09/19/96	283	268	277		09/19/96	936	929	932	
09/20/96	503	489	496		09/20/96	292	272	280		09/20/96	937	934	935	
09/21/96	508	489	499		09/21/96	292	282	286		09/21/96	943	935	939	
09/22/96	506	491	498		09/22/96	299	287	291		09/22/96	944	940	941	
09/23/96	503	485	494		09/23/96	295	288	292		09/23/96	941	938	940	
09/24/96	504	489	497		09/24/96	289	281	285		09/24/96	943	938	940	
09/25/96	508	489	499		09/25/96	292	282	285		09/25/96	948	939	943	
09/26/96	503	484	493		09/26/96	298	285	289		09/26/96	946	942	944	
09/27/96	507	489	498		09/27/96	293	279	289		09/27/96	942	934	938	
09/28/96	497	479	491		09/28/96	282	273	276		09/28/96	941	937	938	
09/29/96	503	484	493		09/29/96	287	273	279		09/29/96	946	940	942	
09/30/96	508	489	499		09/30/96	296	283	290		09/30/96	950	944	946	